QUESTIONNAIRE REPORT ON HYDROGENERATORS FIRE PROTECTION UPDATE STUDY OF THE GROUP 1- USERS' ANSWERS

(September 2009)

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PLEASE READ THIS FIRST:
This version of this paper was prepared for a CARE - *Computer Aided Reading* by means of "hyperlinks" that allow a fast and easy navigation throughout the pages either from the text part or the corresponding annexes.

We encourage you to take advantage of this possibility. The "hyperlinks" are marked by bold underlined text areas (**to activate the hyperlink on WORD version** hold the Control "CTRL" key down then press the left mouse button – pointing at the desired link – **on PDF version** – less precise – just click on the link):
a)- On the Index part the number of the question is the "hyperlink" that leads to the corresponding question.
b)- On the end of each question you find the following "Hyperlink"

[Back to Index] [Go to Annex]

That leads either back to the Index or to the corresponding annex.
c)- On the Annex Part you find at the end of each table the "hyperlink":

[Back to Question]

That makes easy to come back to the corresponding question.

As you can see all efforts were made to ensure an easy and quick reading of this document. Now it's your turn…

D - This is the second step of this task and the biggest one considering the 35 users that contributed with their valuable participation concerning the **Group 1 - Users**. We include herewith for the sake of better understanding all answers related to this group, including those already shown in the first part of this task, as commented in the 2008 Paris Biannual Meeting. We will follow the item numbering of the first part as well as the item numbers of the original Questionnaire (with the numbering correction made in some items). The index of this part of the GFP UPDATE is as follows:

D 1 – **Questionnaire with focus on Users of Hydro Generators (owners)**:

D 1.1 - Are there standards recommending generator fire protection (GFP) in your country?
D 1.1.1 - If yes, which standards are these?

D 1.2 - Do you recommend or install generator fire protection?
D 1.2.1 - What are the reasons for that?

D 1.3 - Is there any difference between the present and past fire protection strategies on generators in your organisation?
D 1.3.1 - If your organization changed the protection strategy, what are the reasons for the change?
D 1.3.2 - Do you intend to change the existing generator fire protection strategy in future and if so please give the reasons.
D 1.3.3 - Do you have a single generator fire protection strategy to cover all the generators or do you have different strategies to cover different generators based on various factors?
D 1.3.3.1 - If your organisation has multiple strategies to cover fire protection of different generators please tick and give brief explanation of the factors which contributed to use different strategies.
D 1.3.3.1.1 - Generator Capacity (MVA):
D 1.3.3.1.2 - Insulation Type (epoxy, polyester, bitumen etc):
D 1.3.3.1.3 - Insulation Temperature Class (Class B, Class F etc):
D 1.3.3.1.4 - Location (remote, underground, surface etc):
D 1.3.3.1.5 - Cooling media (air, windings water cooled, etc):
D 1.3.3.1.6 - Winding design features (roebel, multiturn, soft solder joints etc):
D 1.3.3.1.7 - Generator Age:
D 1.3.3.1.8 - Contamination (carbon dust, oil vapor etc):
D 1.3.3.1.9 - Other factors:

D 1.4 - Is there any requirement for the installation of generator fire protection made by a third party, for instance your insurance company or any authority having jurisdiction?
D 1.4.1 - If yes, is there any specific generator fire protection type recommended? Please specify.
D 1.4.2 - Is this a must or does it implies in reduction of insurance costs?
D 1.4.3 - Is there a joint work between the technical department and the department responsible for the insurance of the plant (s) considering the cost reductions that may be achieved by reducing the risk by means of appropriate fire protection methods?

D 1.5 - Did you have fire in any of your generators in not least than the last 20 years?

D 1.5.1 - Did they occur on the same type of generator?
D 1.5.1.1 - What was the reason for the fire to start? Please tick the relevant box indicating the trigger factor.
D 1.5.1.1.1 - Electrical Fault in the stator winding:
D 1.5.1.1.2 - Electrical fault in the rotor winding:
D 1.5.1.1.3 - Electrical fault in the exciter housing:
D 1.5.1.1.4 - Mechanical Fault in bearings:
D 1.5.1.1.5 - Other Mechanical faults:
D 1.5.1.1.6 - Any other?

D 1.5.2 - Please provide the following information on the units where fires occurred in not least than the last twenty years.
D 1.5.2.1 - Was the unit equipped with fire protection equipment?
D 1.5.2.2 - Did the fire protection system work according to the design specification?
D 1.5.2.3 - Was the fire extinguished solely by the installed generator fire protection system without any additional external help?
D 1.5.2.4 - Did the fire spread outside the generator?
D 1.5.2.5 - Give a brief description of the damage to the generator and surrounding:
D 1.5.2.6 - Were there any direct or indirect fatalities as a result of the fire started in the generator?
D 1.5.2.7 - Was the fire protection designed to trigger automatically in an event of a fire or/and heat detection?

D 1.6 - Do you have different types of fire protection systems within the generators installed in your power plants?
D 1.6.1 - If no, please indicate which is your sole fire protection system:
D 1.6.2 - If yes, please indicate which are yours different fire protection systems you have installed:
D 1.6.3 - In the case of CO_2 please indicate the pressure system used:
D 1.6.4 - Do you have generators with open circuit ventilation?

D 1.7 - In your opinion/experience what is the most efficient fire extinguishing media?
D 1.7.1 - Which media is harmful to the machines?
D 1.7.2 - Which media is harmful to the human health?
D 1.7.3 - Is there any environmental concern bound to any media currently in use?

D 1.8 - Do you specify measures to prevent accidents to personnel?
D 1.8.1 - Do you specify measures to prevent damage to machine?

D 1.9 - By what means is the existing generator fire extinguishing system is designed to release?
D 1.9.1 - What is your opinion or preferred method, as to how the generator fire extinguishing system should be released?

D 1.10 - How is the fire detected in your generators?
D 1.10.1 - Do you have any comment about the efficiency of these detectors (heat and/or smoke)?

D 1.11 - How do you prevent unwanted (unnecessary-accidental) release of generator fire extinguishing system?
D 1.11.1 - At your present installation did you have unwanted (unnecessary-accidental) release of generator fire extinguishing system with consequent release of extinguishing media?

D 1.12 - In an event of fire is detected by the devices installed (eg. Smoke, heat etc), will extinguishing media release immediately without any delay or any manual interference?

D 1.13 - Do you consider bearings as a potential fire hazard for generators?
D 1.13.1 - Are your generator fire protection systems designed to fight bearing fires?

D 1.14 - Do you specify provisions to remove fire extinguishing media?

D 1.15 - Do you specify automatic open/close relief vents on the generator housing to relieve excessive inrush extinguishing media pressure while maintaining extinguishing media concentration within the generator housing for the specified extinguishing time?

D 1.16 - What is the maximum number of machines protected by one storage?

D - 1.16.1 - Do you have main and reserve storage for each group of protected machines?

D 1.17 - What is the future trend for extinguishing media?

D 1.18 - What is the future trend for fire detection?

D 1.19 - In case of fire, smoke constitutes a major problem on visibility, orientation, breathing capacity, etc. Therefore it is desirable to provide adequate means of combating while involving minimum risk to personnel. In this line please check which additional provisions you do foresee in your plants:

D 1.19.1 - Additionally to these items the existence on an Emergency Plan, a Fire Brigade and Simulations are very actual, being so please answer the following items:

D 1.20 - Considering the existence of the recently launched standards (for instance NFPA 851), is there a need of any additional specific international standard on generator fire protection?

D 1.21 - According to your opinion, is there any question that is missing in this part of the questionnaire?

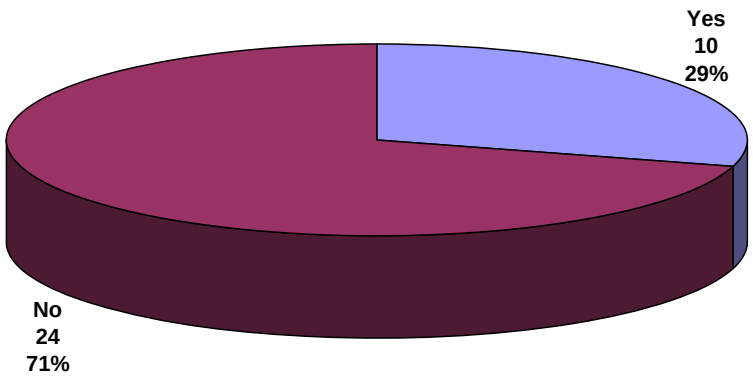
Now passing to the detailed discussion of each item, not forgetting that the pertinent tables with the statistical records of all items are shown in the annex, we have:

D 1.1 -

1.1) Are there standards recommending generator fire protection (GFP) in your country? ☐ - Yes ☐ - No

This question was made as a check-box question with Yes and No alternative, and for this group the answers resulted in the following graphic (the corresponding questionnaires and the resulting statistical tables are available in the corresponding annexes):

1.1 - Are there standards recommending generator fire protection (GFP) in your country?



This survey has 1 Blank answer – not considered in the graph.

This shows that the majority (68%) of the answers indicated that no local standards exist.

We repeat the consideration made formerly: this question raised some polemic since many non Americans answered considering NFPA as national standard which of course cannot be accepted in this case. By the way the Convener's comment to this issue is that the NFPA standards are still really the state of the art in this case and could within some boundaries be considered as "global standards" – but the question's intention was to find out if there are specific national (local) standards for GFP in the several countries involved.

[Back to Index] [Go to Annex]

GENERAL REMARK: for the sake of better interpretation of the graphics the items as "Blank", "Not applicable", "Did not Answer", "Answer does not match the subject asked" and alike that are not relevant to every survey in screen will not be shown in the graphic, but they will be clearly indicated either below the graphic or on the corresponding tables.

D 1.1.1-

1.1.1) If yes, which standards are these?

We got answers from the following countries telling that they have Standards in their countries giving the corresponding names:

Canada
China
Macedonia
Mexico
Poland
Russia
Switzerland
USA

NOTE: Mexican companies answered twice and one company answered "Non local Standards" thus the number of countries that confirmed to have own Standards is 8 (eight) among the 20 participant countries. To give an example of the information received we reproduce the comment received from the Canadian User coded EMP032: "*National Fire Protection Association NFPA 850 and 851), Manitoba Hydro Fire Manual, Factory Mutual Loss Data Sheets, & Best Industry Practices. First of all Factory Mutual Global is our Corporate insurer. A member of FM Global also serves on the NFPA 850, 851, and 853 Committees. Therefore, I have direct and indirect affiliation with the FM Global. In Canada, the National Fire Code references back to the NFPA Codes and Standards and therefore, they are regarded as mandatory. We follow these NFPA Codes and Standards very diligently, unless otherwise, over ruled by an Authority Having Jurisdiction (AHJ)." On the other hand in Macedonia the User coded EMP027 explains the following: "Standard JUS accepted by R. Macedonia after the split from former Yugoslavia to separated Republics, now this is a national Macedonian Standard.*"

The complete answers can be seen in the corresponding annex.

[Back to Index] [Go to Annex]

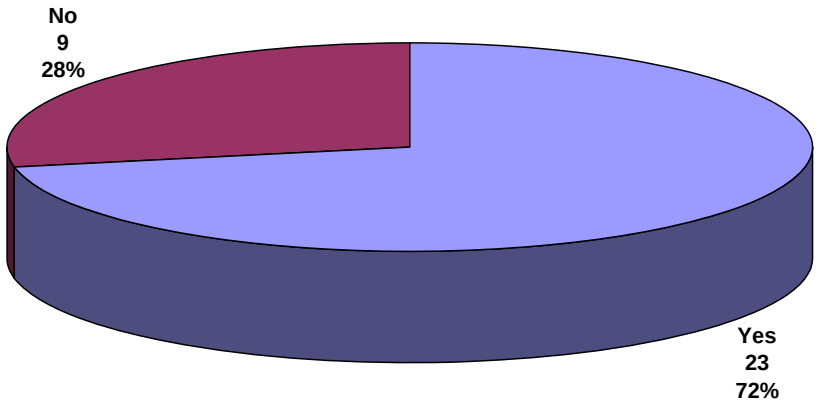
D 1.2 -

1.2) Do you recommend or install generator fire protection?

☐ - Yes ☐ - No

This is the basic question about the recommendation of the installation of Generator Fire Protection, starting with the direct YES or NO question resulted for this group in the following graphic:

1.2 - Do you recommend or install generator fire protection?



This survey has 1 Blank answer – not considered in the graph.

This results where complemented with the question below.

[Back to Index] [Go to Annex]

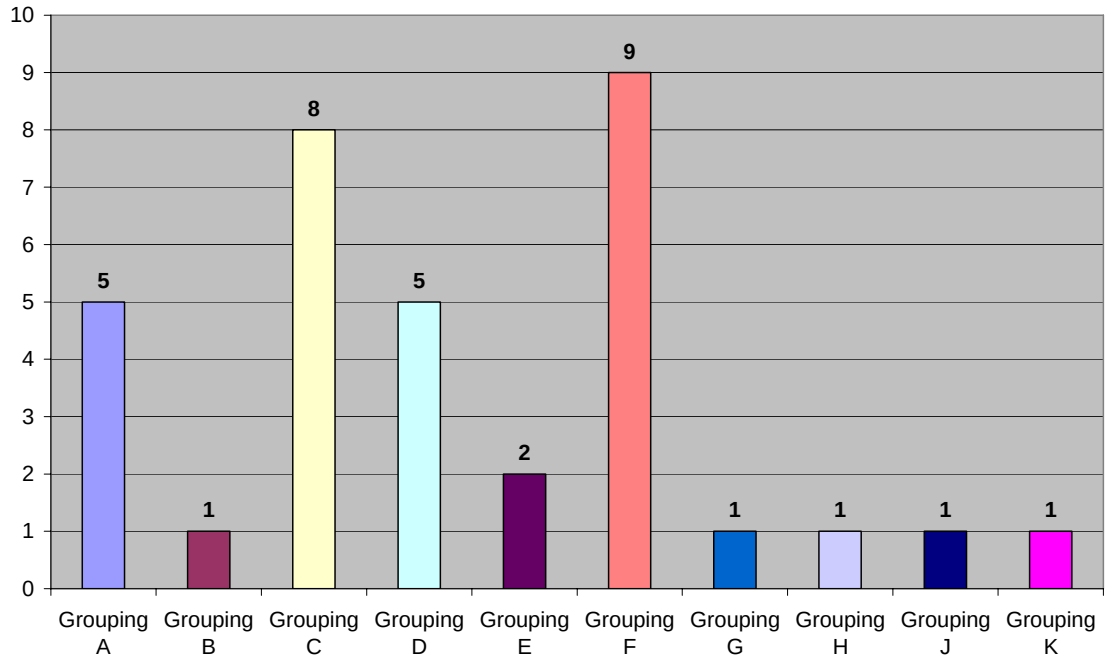
D 1.2.1 -

1.2.1) What are the reasons for that?

This open control question was made to gather more data on this critical question and to draw any conclusion we will have to balance also the following answers' statistics.
As an open question allows we got several different answers which were classified in "**Groupings**" in order to allow a statistical survey on the answers tendency (from time to time we will remind that the original answers as well as the complete statistical tables of the items concerned herewith are available on the corresponding annexes).

1.2.1) What are the reasons for that?

Grouping	Legend	Quantity
Grouping A	Safety (and safety reasons)	5
Grouping B	By observed occurrences	1
Grouping C	Do not install	8
Grouping D	Protection	5
Grouping E	Insurance (company) requirement	2
Grouping F	Reduce or minimize damages	9
Grouping G	Safety and reduce damages	1
Grouping H	In process of removing GFP	1
Grouping I	Did not answer (not considered for the graphic)	1
Grouping J	Smaller than 10 MVA not; bigger yes	1
Grouping K	Only for asphalt and shellak insulation system otherwise not	1



If we analyze the Grouping C [Do not install] we see that 8 do not install but the Groupings A [Safety (and safety reasons)] +D [Protection] +F [Reduce or minimize damages] =19 do install thus keeping the consistency of the first question made. It is interesting to recall the Grouping F that mentioned "reduce or minimize damages" and this seems to be the key issue from the User stand point, it means how to get the equipment on grid as soon as possible after an accident.

This is a crucial controversial question therefore some of the comments received are reproduced below (the complete set of comments can be seen on the corresponding annex):

Considering the Grouping **A** [Safety (and safety reasons)] the Mexican User coded EMP021 quoted the following: "*Safety and security of facilities and staff*."

Considering the Grouping **B** [By observed occurrences] the Brazilian User coded EMP008 stated that: "*By observed occurrences around the world*."

Considering the Grouping **C** [Do not install] the Brazilian User coded EMP013 explained the following: *Our company does not adopt GPF for the following reasons: 1) Current projects apply more heat resistant, self-extinguishing and fire retardant materials (class " F "); 2) The digital protections offer a fast detection of the of electromechanical and dielectric causes and eliminate them in a few cycles, besides the fact that they have redundancies and are; 3) The electric energy sources cut, main contributor in the heat generation and fire outbreaks, are instantaneous; 4) An inappropriate or unintended actuation of the "GFP" may cause long unavailability of the generating unit; 5) The construction of tight compartments for hydro generators; 6) Adoption of an adequate policy of operating and maintenance; and finally, 7) Since our foundation(1952) and having currently more than 50 production units in operation there is no record of fire within the compartment of a hydro generator.*

Considering the Grouping **D** [Protection] the Brazilian User coded EMP025 stated that: "*Generator protection in the event of severe electrical faults. Hazards minimization Personnel protection*"

Considering the Grouping **E** [Insurance (company) requirement] the Polish User coded EMP053 told the reason as being: "*Mainly due to that insurance company insists to do it rather than to reduce scope of damages*."

Considering the Grouping **F** [Reduce or minimize damages] the User EMP033 from New Zealand stated that: "*Prevent major damage to generators, minimize risks to personnel on site, and minimize risks of generator fire spread to other parts of the powerhouse. Appropriately designed and maintained generator fire protection systems are a good "insurance policy" to minimize fire damage to generators, and to ensure quick turnaround from a fire condition to return to generating service in as short a possible time. Without generating fire protection systems we would find ourselves at increased*

risk of fire damage, and also an increased risk of generator unit downtime due to fire damage. This is not a position we want to be in, and we see generator fire protection systems as a good risk mitigation measure."
Considering the Grouping **G** the [Safety and reduce damages] Chinese User coded EMP021 quoted the following: "*To guarantee the generator operation in reliability and safety as well as to decrease and shorten the extinction and duration of short circuit accident to a minimum*."
Considering the Grouping **H** [In process of removing GFP] the Spanish User coded EMP023 stated that: "*Nowadays, fire protection systems are being removed with the programmed rewinding processes of the generators, and it is recommended fireproof insulations*."
Considering the Grouping **J** [Smaller than 10 MVA not; bigger yes] the Macedonian User coded EMP027 stated that: "*Fire protection is not necessary for power of generator less than 10 MVA. For the power of generator more than 10 MVA fire protection is recommended by actual standards. According our long period of operation (more than 50 years) and experience with 9 generators, this obligation from the standard should be discussed."*
Considering the Grouping **K** [Only for asphalt and shellak insulation system otherwise not] the Swedish User coded EMP047 stated that: "*We only use fire protection on asphalt and schellak insulation system. We don use fire protection on generator windings with epoxy insulation systems*."

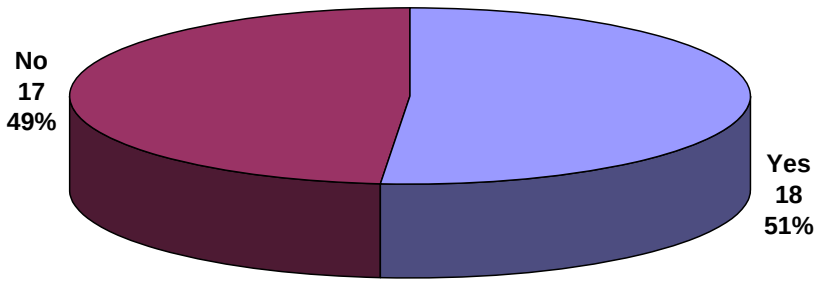
[Back to Index] [Go to Annex]

D 1.3 -

1.3) Is there any difference between the present and past fire protection strategies on generators in your organisation? ☐ - Yes ☐ - No

Recalling a question made in the original work made in 1981 about "Difference between the present and the past fire ptotection stategies" we had the opportunity to collect closed answers from this group as follows:

1.3 - Is there any difference between the present and past fire protection strategies on generators in your organisation?



In order to explore the present tendencies on this item two additional open type questions were made for the Users, the results are stated in the folowing items.

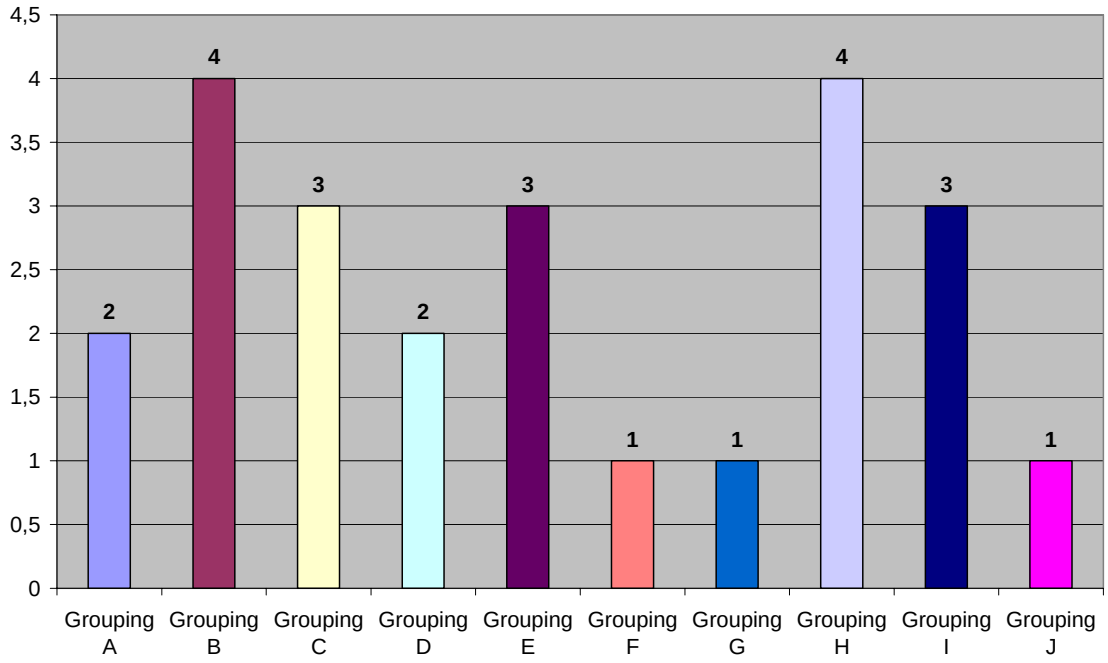
[Back to Index] [Go to Annex]

D 1.3.1 -

1.3.1) If your organization changed the protection strategy, what are the reasons for the change?

1.3.1) If your organization changed the protection strategy, what are the reasons for the change?

Grouping	Legend	Quantity
Grouping A	No Changes	2
Grouping B	Remove GFP with use of new insulation material	4
Grouping C	Implement water	3
Grouping D	To prevent unnecessary releases	2
Grouping E	To improve availability and effectiveness	3
Grouping F	Improvement in detection	1
Grouping G	Removing CO2	1
Grouping H	Changes depend upon insulation type	4
Grouping I	Focus on man security and environment	3
Grouping J	Changes will depend on GFP behavior	1
Grouping K	Not applicable (not considered for the graphic)	1
Grouping L	Did not answer (not considered for the graphic)	10



The Grouping H [Changes depend upon insulation type] calls for the dependency to the insulation type, the same criteria was mentioned by the Grouping B [Remove GFP with use of new insulation material – here the question of "*non flammable*" insulation acts significantly] but already calling for removal of the installed GFP and other significative groups call for the installation of GFP wiht water as extinguishing media, measures to improve availability and effectiveness and focus on man security and environment.

This is an important question that received many comments therefore some of them are reproduced below (the complete set of comments can be seen on the corresponding annex):
Considering the Grouping **A** [No Changes] the Brazilian User coded EMP045 quoted the following: "*Basically the organization uses the same strategy from de Eighties*."
Considering the Grouping **B** [Remove GFP with use of new insulation material] the Austrian User coded EMP054 stated that they are: "*Removing CO2 fire fighting plants (hazard for*

staff), replacing flammable material by flame retardant and self extinguishing material, brazing of stator windings instead of soft soldering."
Considering the Grouping **C** [Implement water] the Australian User coded EMP039 explained the following: "*In the past we had CO2 protection on all our units. Moving from CO2 to water based protection on the basis of safety and effectiveness of existing CO2 systems. Now we are in the process of installing water based fire protection only on some generators based on risk analysis.*"
Considering the Grouping **D** [To prevent unnecessary releases] the Macedonian User coded EMP027 quoted the following: "*Many unnecessary activation of fire protection of generator.*"
Considering the Grouping **E** [To improve availability and effectiveness] the Mexican User coded EMP031 explained the following: "*Improve and upgrade existing CO2 and foam systems*."
Considering the Grouping **F** [Improvement in detection] the Brazilian User coded EMP025 stated that: "*Our company's fire detection system is composed of thermal and smoke detectors. CO2 is discharged whenever a thermal detector and a smoke detector operate. A first change was introduced in order to allow the fire protection system operation in the event of severe faults which could cause the opening of the generator doors and hatches. In 1992, due to an explosion caused by a stator fault, the generator doors opened and their micros witches blocked the fire protection system operation. In order to allow the future operation of the fire protection system in the case of severe faults, the phase differential (87G) and turn-to-turn (87SP) protections were connected in parallel with the micro switches. A second change was introduced due to an improper operation of one generator fire protection system in 2007. The release of CO2 and the generator trip were caused by a thermal and a smoke detector incorrect operation. In order to prevent this kind of incorrect behavior, the fire protection system control panel output was connected in series with protections 87G and 87SP*."
Considering the Grouping **G** [Removing CO2] the Japanese User coded EMP028 quoted the following: "*For reducing the human damage in consideration, CO2 is no longer applied to the fire extinguishing system.*"
Considering the Grouping **H** [Changes depend upon insulation type] the Norwegian User coded EMP040 stated that: "*Change from bitumen based to modern epoxy or polyester based stator winding insulation*."
Considering the Grouping **I** [Focus on man security and environment] the New Zealand User coded EMP033 explained the following: "*More focus on reducing fire risks to personnel, rather than focusing on the generating plant alone*."
Considering the Grouping **J** [Changes will depend on GFP behavior] the Japanese User coded EMP043 stated that: "*We will change the protection strategy when we find the important defect on fire protection*."

[Back to Index] [Go to Annex]

D 1.3.2 -

1.3.2) Do you intend to change the existing generator fire protection strategy in future and if so please give the reasons.

This open type question was meant to explore the reasons those who may intend to make changes:

1.3.2) Do you intend to change the existing generator fire protection strategy in future and if so please give the reasons.

Grouping	Legend	Quantity
Grouping A	No, no changes	20
Grouping B	Installing water + VESDA	1
Grouping C	Studying the elimination of GFP for small and medium units	1
Grouping D	Changing insulation and removing GFP	2
Grouping E	Depends of machine type	1

Grouping F	Removal of CO2	1
Grouping G	Not applicable	2
Grouping H	Formerly only equipment protection, nowadays personnel security, maintenance aspects, costs, new materials.	2
Grouping I	Did not answer	5

In this case the majority of answers did indicate that no changes are planed. But the Grouping C [Studying the elimination of GFP for small and medium units] shows what may be a tendency. Ans the Grouping B [Installing water + VESDA] mentions VESDA that is a sophisticated smoke detection system that now is appearing in Waterpower applications; it also shows another tendecy that is the use of water.

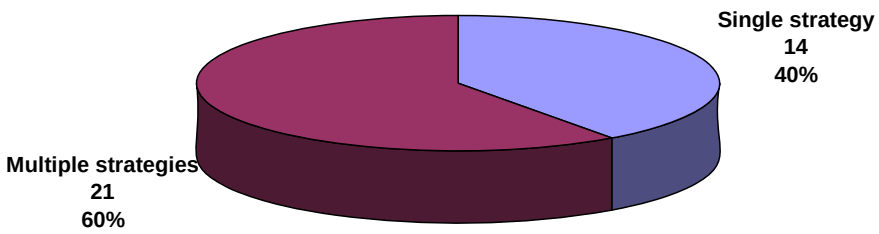
[Back to Index] [Go to Annex]

D 1.3.3 -

1.3.3) Do you have a single generator fire protection strategy to cover all the generators or do you have different strategies to cover different generators based on various factors? Please tick the relevant box: ☐ - Single strategy ☐ - Multiple strategies

This item was first stated as a check-box question for which the following answers were received:

1.3.3) Do you have a single generator fire protection strategy to cover all the generators or do you have different strategies to cover different generators based on various factors?



[Back to Index] [Go to Annex]

D 1.3.3.1 - In order to survey this item deeper a series of correlated questions in form of check box with the request of a brief explanation note, the original text for this exploratory questions was:

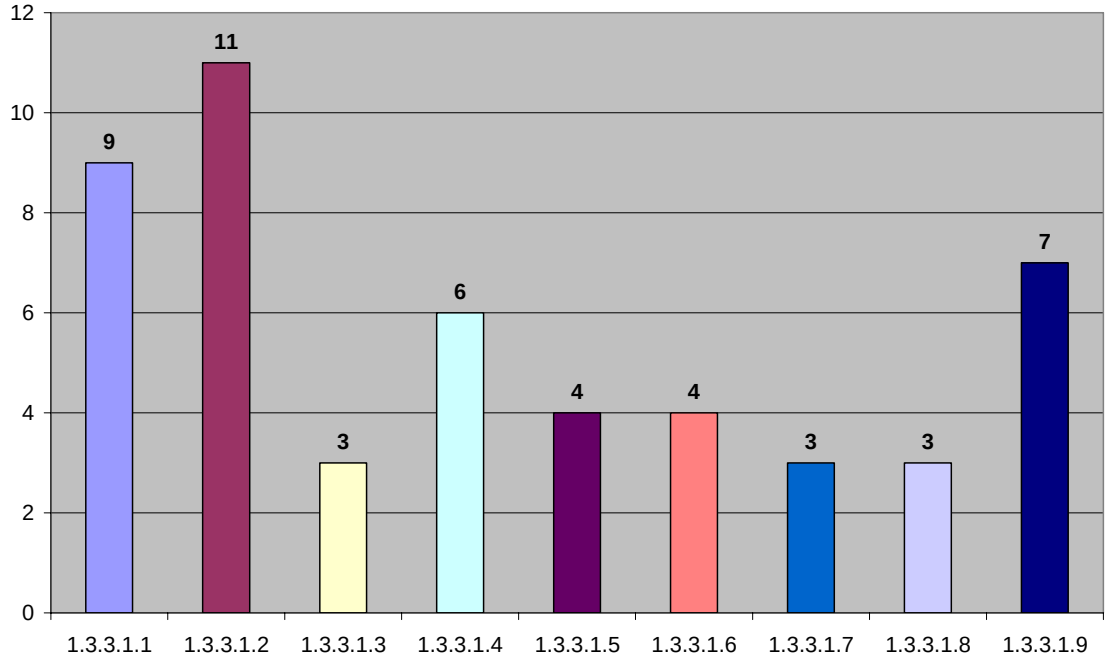
Original Questionairry's Question:
1.3.3.1) If your organisation has multiple strategies to cover fire protection of different generators please tick and give brief explanation of the factors which contributed to use different strategies, as follows:

The following additional questions were made (here shown with the original numbering):

1.3.3.1.1) Generator Capacity (MVA)

1.3.3.1.2) Insulation Type (epoxy, polyester, bitumen etc)
1.3.3.1.3) Insulation Temperature Class (Class B, Class F etc)
1.3.3.1.4) Location (remote, underground, surface etc)
1.3.3.1.5) Cooling media (air, windings water cooled, etc)
1.3.3.1.6) Winding design features (roebel, multiturn, soft solder joints etc)
1.3.3.1.7) Generator Age
1.3.3.1.8) Contamination (carbon dust, oil vapor etc)
1.3.3.1.9) Other factors

The result of the check box questions was the following:



In this analysis we got 16 contributors that answered that these questions are not applicable (NA) to them either because they have only one GFP stategy or because they do do not have GFP installed at all.

From the graphic above we can see that the most indicated reason for having multiple stategies is “insulation type” followed by “other factors” and “location”.

The contributions to this item are very reach in details, showing a high degree of collaboration will, and a separate analysis of each one of them show the following results. For this study the items, for which a significant amount of additional explanatins were given, were studied by means of a categorization of related explanations that allowed the issue of graphics (the original texts of the additional explanationa can be seen in the corresponding annexes).

[Back to Index] [Go to Annex]

D 1.3.3.1.1 -

Original Questionnairy’s Question:
1.3.3.1.1) Generator Capacity (MVA) ☐ - Yes ☐ - No Brief explanation note:

The check box question gave the following result: Yes = 9
Here the “Yes” value is significative to the analysis. In principle the quantity of consistent open type answers should be limited in this case to 9, but some Users contributed even it they did not mark the corresponding check-box type question. The

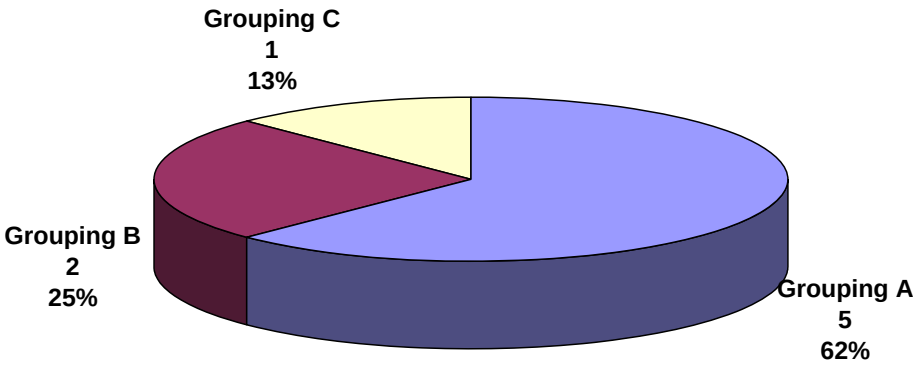
“additional” explanation is interesting for the gathering of experience. This explanation is valid for the next question until D-1.3.3.1.9

[Back to Index] [Go to Annex]

Open question analysis results (brief explanation note):
For this question the given additional explanations could be categorized as follows:

1.3.3.1.1) Generator Capacity (MVA) Brief explanation note:		
Grouping A	Consider a minimum power limit to install GFP	5
Grouping B	Consider if it is an open unit (not applied) or a closed (apply)	2
Grouping C	Considering A+B	1
Grouping D	Answer does not match the subject asked (not considered for the graphic)	2
	Total of answered questions	**10**

1.3.3.1.1) Generator Capacity (MVA) Brief explanation note



The majority of additional explanations on this item point to the consideration of a minimum generator capacity as parameter for the decision of installing GFP. An example of the comments given to this item was the comment of the Brazilian User coded EMP016: “*Low capacity machines, with open air ventilation, have no fire protection system installed*.” Please refer to the corresponding annexes for the other comments.

[Back to Index] [Go to Annex]

D 1.3.3.1.2 -

1.3.3.1.2) Insulation Type (epoxy, polyester, bitumen etc) ☐ - Yes ☐ - No
Brief explanation note:

The check box question gave the following result: Yes = 11.
Thus for 11 Users the decision to the type of insulation was the reason for having multiple strategies, this may happen with an User that has generators with bitumen with CO_2 GFP and generators with epoxy where the GFP’s media is water, for instance.

[Back to Index] [Go to Annex]

Open question analysis results (brief explanation note):
For this question the given additional explanations could be categorized as follows:

1.3.3.1.2) Insulation Type (epoxy, polyester, bitumen etc). Brief explanation note:		
Grouping A	With epoxy insulation no GFP	1
Grouping B	Do not consider that likelihood or consequences of fire greatly increased by type of ground insulation material	1
Grouping C	With bitumen insulation is mandatory	1
Grouping D	Consider both A+C	3
Grouping E	Answer does not match the subject asked	2
	Total of answered questions	**8**

The analysis here shows that the Category D [With epoxy insulation no GFP + With bitumen insulation (GFP) is mandatory] was the most indicated. As an example of the additional explanations given for this item by the Swedish User coded EMP047: "*No protection on Epoxy class F, after a fault the unit will trip. On asphalt and schellak windings class B there will be a fire detection system and depending on the relay protection system some will have CO2 protection (most of the units have CO2) and some will go to stop*." The others can be seen on the corresponding annex.

[Back to Index] [Go to Annex]

D 1.3.3.1.3 -

1.3.3.1.3) Insulation Temperature Class (Class B, Class F etc) ☐ - Yes ☐ - No

Brief explanation note:

The check box question gave the following result: Yes = 5

[Back to Index] [Go to Annex]

Open question analysis results (brief explanation note):
In this item only two comments were given and no categorization was necessary. We reproduce one of the comments in this case given by the Australian User coded EMP039: "*We do not consider that likelihood of fire or consequences greatly increased by type of insulation temperature class or operating temperature*."

[Back to Index] [Go to Annex]

D 1.3.3.1.4 - **Location (remote, underground, surface etc)**:

Original Questionnairy's Question:
1.3.3.1.4) Location (remote, underground, surface etc) ☐ - Yes ☐ - No
Brief explanation note:

The check box question gave the following result: Yes = 6

[Back to Index] [Go to Annex]

Open question analysis results (brief explanation note):
Although five additional comments were given (one check box got no comment) they were different one from each other not allowing a categorization to be made. We reproduce the comment given by the New Zealand User coded EMP033: "*The risks of a generator fire to personnel have higher consequences in underground power stations compared to surface power stations. We undertake a risk assessment to determine emergency egress times for personnel which is an input into deciding whether the generator fire protection system should employ a clean agent gas to minimize risks to personnel, or whether a CO2 system would be adequate."* For the others please refer to the corresponding annex.

[Back to Index] [Go to Annex]

D 1.3.3.1.5 -

1.3.3.1.5) Cooling media (air, windings water cooled, etc) ☐ - Yes ☐ - No
Brief explanation note:

The check box question gave the following result: Yes = 4

[Back to Index] [Go to Annex]

Open question analysis results (brief explanation note):
Although only four checked "yes" there are six comments. The explanation for that is that one company indicated that has single strategy on the question 1.3.3 and decided to give a comment (in fact this was not necessary). Other two in spite of having answered "no" in the check box part decided to state a comment. Similar situations occurred in other questions.

There were too little different alternatives among the received additional comments and four informed to have only air-cooled generators. One of the comments is the following given by the German User coded EMP048: "*Only air cooled generators in operation in our business unit*."

[Back to Index] [Go to Annex]

D 1.3.3.1.6 -

1.3.3.1.6) Winding design features (roebel, multiturn, soft solder joints etc) ☐ -Yes ☐ -No Brief explanation note:

The check box question gave the following result: Yes = 4

[Back to Index] [Go to Annex]

Open question analysis results (brief explanation note):
Also in this question there were few additional answers and in this case two alternatives, each one with two answers. These alternatives refer to soft soldered joints and Roebel bars respectively.

[Back to Index] [Go to Annex]

D 1.3.3.1.7 -

1.3.3.1.7) Generator Age ☐ - Yes ☐ - No
Brief explanation note:

The check box question gave the following result: Yes = 3

[Back to Index] [Go to Annex]

Open question analysis results (brief explanation note):
This question received four comments. One of the companies although answered "no" decided to state a comment. These alternatives can be seen on the corresponding annex. The answers relay on the age of the winding, its conditions, and the following given by the Australian User coded EMP039 opposed to the others: "*We do not consider that likelihood of fire or consequences greatly increased by type of age as most of our generators falls into 30-50 year bracket*."

[Back to Index] [Go to Annex]

D 1.3.3.1.8 -

1.3.3.1.8) Contamination (carbon dust, oil vapor etc) ☐ - Yes ☐ - No
Brief explanation note:

The check box question gave the following result: Yes = 3

[Back to Index] [Go to Annex]

Open question analysis results (brief explanation note):
This item got two comments, one of them given by the Mexican User coded EMP031 refer to "*carbon dust and oil vapor*".

[Back to Index] [Go to Annex]

D 1.3.3.1.9 -

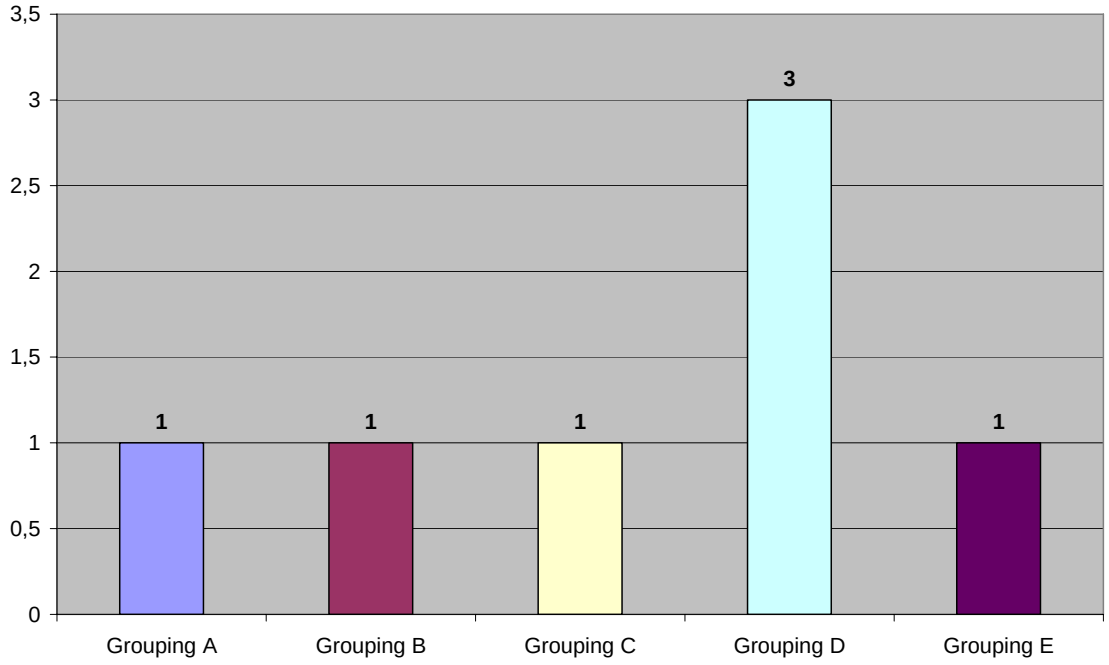
1.3.3.1.9) Other factors ☐ - Yes ☐ - No Please specify these other factors and give a brief explanation note:

The check box question gave the following result: Yes = 7

[Back to Index] [Go to Annex]

Open question analysis results (brief explanation note):
For this question eight additional comments were given and the result of the categorization is the following:

1.3.3.1.9) Other factors. Please specify these other factors and give a brief explanation note:		
Grouping A	Influence of bearing and if horizontal / vertical generator	1
Grouping B	Attention to business consequences of Loss	1
Grouping C	Depends on Early warning detection or conventional detection	1
Grouping D	Electrical system and relay protection. redundancy, quality, fast relay etc.	3
Grouping E	High humidity	1
Grouping F	Answer does not match the subject asked (not considered for the graphic)	1
	Total of answered questions	**8**



New aspects were added to those that were indicated in the alternatives 1 to 8, as shown in the categories above.

One example of the category “D” [Electrical system and relay protection. redundancy, quality, fast relay etc.] is the additional comment given by the Brazilian User coded EMP020: “*The fire extinguishing method is one: through the CO2 application. However, there are different forms to deploy the discharge of the gas, which varies in function of the time in which the plant was constructed or even of the manufacturer of the machine. Basically, the application methods are the following ones: 1) The CO2 discharge and the machine stopping is triggered by the actuation of any one of these relays: 87G (differential) or 49C (thermostat); or 2) The CO2 discharge and the machine stopping is triggered by the actuation of the logic: 87G+ smoke detector or 87G+ temperature detector.*”

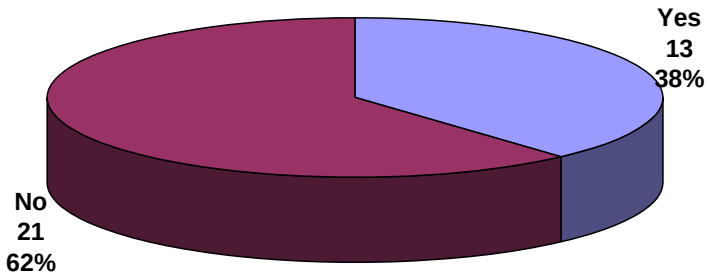
[Back to Index] [Go to Annex]

D 1.4 -

1.4) Is there any requirement for the installation of generator fire protection made by a third party, for instance your insurance company or any authority having jurisdiction? ☐ - Yes ☐ - No

This question and the following three intend to survey if there are other reasons to install GFP other than an internal safety policy of the company; and if there is an internal work aiming cost reductions related to the GFP application.
The first part is a check box question that resulted in the following ratings:

1.4) Is there any requirement for the installation of generator fire protection made by a third party, for instance your insurance company or any authority having jurisdiction?



This survey has 1 Blank answer – not considered in the graph.

This step of the question shows that for the majority of the companies there is no requirement for the installation of GFP stated by a third party.

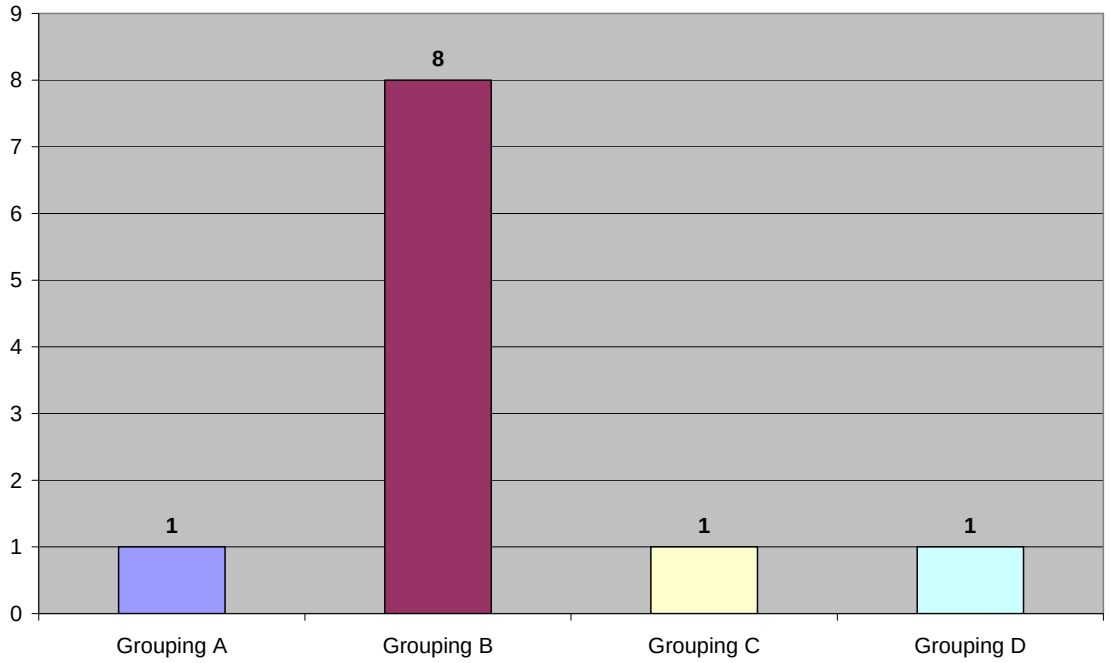
[Back to Index] [Go to Annex]

D 1.4.1 -

1.4.1) If yes, is there any specific generator fire protection type recommended? Please specify.

This is a pure open question with a possibility to get 13 answers at most.

1.4.1) If yes, is there any specific generator fire protection type recommended? Please specify.		
Grouping A	CO_2	1
Grouping B	No, no specific system is recommended by a third party	8
Grouping C	Water is recommended by the insurer	1
Grouping D	Several systems are recommended	1
Grouping E	Answer does not match the subject asked (not considered for the graphic)	2
	Total of answered questions	**13**



In most of the cases when GFP is required by a third party there is no specific system required.

Note: I some cases the answers given do not match the subject asked and this was taken as a “grouping”; in this particular case the “E”.

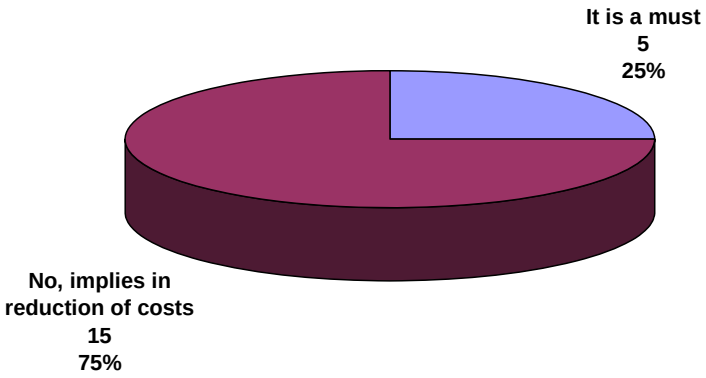
[Back to Index] [Go to Annex]

D 1.4.2 -

1.4.2) Is this a must or does it imply in reduction of insurance costs?
☐ - It is a must ☐ - No, in fact it implies in reduction of insurance costs
Please comment:

Here the question was stated giving two alternatives that got the following rating:

1.4.2) Is this a must or does it imply in reduction of insurance costs?

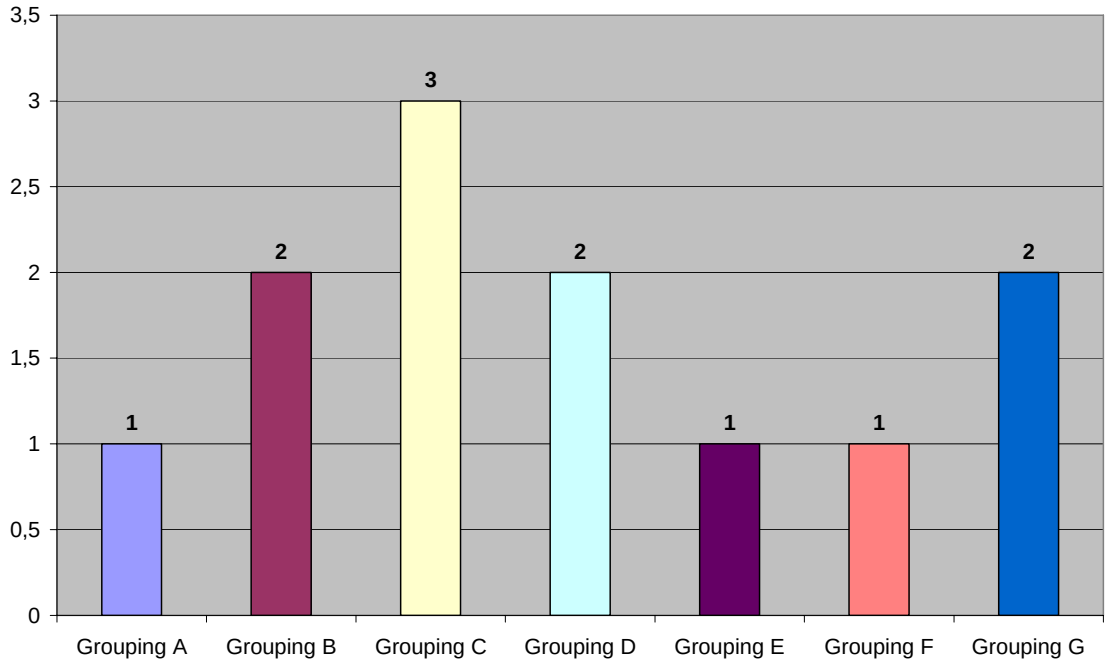


This survey has 15 Blank answers – not considered in the graph.

[Back to Index] [Go to Annex]

Open question analysis results (please comment):
In order to profit from the contributors experience a request for comments was stated with the following open question result:

1.4.2) Is this a must or does it imply in reduction of insurance costs? Please comment:		
Grouping A	Does not use and justifies towards the authorities and insurance company	1
Grouping B	Installation of GFP is regulated by the authorities in charge, or is regulated by Law	2
Grouping C	Implies in an insurance premium reduction	3
Grouping D	Simplifies the process of getting money from the insurer should an accident occur; or makes it easier to get a coverage	2
Grouping E	Is requested by the insurance company	1
Grouping F	There is no specific requirement	1
Grouping G	Does not imply in insurance premium reduction; but may be recommended	2
Grouping H	Answer does not match the subject asked (not considered for the graphic)	1
	Total of answered questions	**13**



The answers show the tendency in each company and the Grouping C was more selected and an example of the complete answers received (this one given by the Brazilian User coded EMP045) that can be seen in the annex is the following: "*Our strategy is to use generator fire protection for all the machines. Recently this strategy contributed for a reduction of costs in the contracts with the insurance company for all our power plants*."

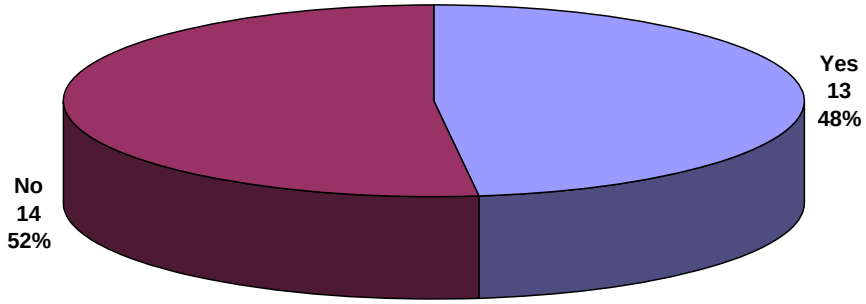
[Back to Index] [Go to Annex]

D 1.4.3 -

1.4.3) Is there a joint work between the technical department and the department responsible for the insurance of the plant (s) considering the cost reductions that may be achieved by reducing the risk by means of appropriate fire protection methods? ☐ - Yes ☐ - No Please comment if applicable:

This item started with a check up question that gave the following result:

1.4.3) Is there a joint work between the technical department and the department responsible for the insurance of the plant (s)?



This survey has 8 Blank answers – not considered in the graph.

[Back to Index] [Go to Annex]

Open question analysis results (please comment if applicable):
An almost even result was obtained and in this case the requested additional comments may help to understand the situation inside the companies involved.

1.4.3) Is there a joint work between the technical department and the department responsible for the insurance of the plant (s) considering the cost reductions that may be achieved by reducing the risk by means of appropriate fire protection methods? Please comment if applicable:		
Grouping A	Confirmed the cooperation work aiming price reduction	3
Grouping B	Confirmed that there is NO cooperation work aiming price reduction	1
Grouping C	Answer shows a misunderstanding of the question	3
Grouping D	Answer does not match the subject asked	3
	Total of answered questions	**10**

Ten additional comments were received in this case and the analysis of the same showed that six of them did not correspond to what was asked; either because the aspect of cost reductions did not occur or because the explanations really did not focus the requested information. From the remaining answers three confirmed that an internal cooperation exists. One of these additional explanations is the following: "*(The check up question was answered with 'Yes') the joint work, was carried through in order to reduce the costs of the insurance using level risks parameters*"
As an example of answer that did not match, at least entirely, the asked condition was: "(*The check up question was answered with 'Yes'*) *but no direct reduction in insurance premiums to justify fire protection*". The complete answers can be seen in the annex.

This analysis did show that in some companies there is a joint work aiming the use of internal synergy in order to reduce costs by the application of GFP following the procedure requested by the insurers this resulting in costs reduction.

[Back to Index] [Go to Annex]

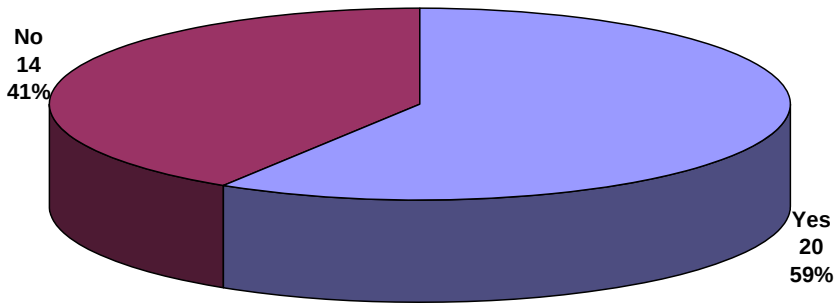
D 1.5 -

1.5) Did you have fire in any of your generators in not least than the last 20 years?
☐ - Yes ☐ - No
If yes, how many?

This is a very important part of this work because it shows the real experience on occurred accidents in generators. In fact the question stated was specific recalling the occurrence of **FIRE** in generators. From the standpoint of the responsible Convener the answers were taken as received, although a discussion about the definition of what has to be considered as fire was raised during the elaboration of the work.
One definition of what should be considered fire in a generator when we look at the need for fire suppression systems would be "*burning that is sustained once the ignition source is removed*". But there are many surrounding conditions to be evaluated though…
In this respect an important contribution offered by one knowledgeable expert from the USA calls for the following consideration: "*As one can recognize, the oxygen and heat are present if no suppression is available. The question then becomes whether or not the fuel exists to support a chemical reaction – according to the Fire scheme. Manufacturers suggest that the current materials (epoxy based materials) will not burn if the heat is removed.*
However, many times the heat is so intense that even if the "flash" that started the ignition is removed, the epoxy forms combustible gas (in the contained environment of the air housing) via a chemical reaction, and it becomes the fuel source."

The result of the check box question of the item 1.5. was the following:

1.5) Did you have fire in any of your generators in not least than the last 20 years?



This survey has 1 Blank answer – not considered in the graph.

[Back to Index] [Go to Annex]

Open question analysis results (if yes, how many?):
The answer for the question "**If yes, how many?**" resulted in **64** generators indicated by the 20 companies. Quantity equalization with the question 1.5.5.1 was made and some information given in this item was corrected considering the information given in the tables for more than one generator – "Form for multiple machines". Generally only the number of units was indicated but some additional comments were given and can be seen in the corresponding annex.

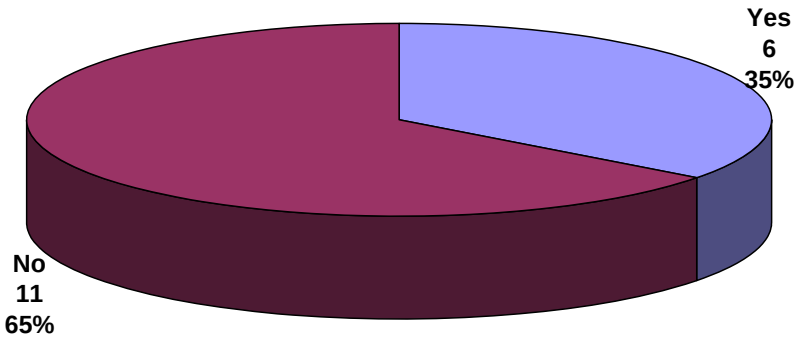
[Back to Index] [Go to Annex]

D 1.5.1 -

1.5.1) Did they occur on the same type of generator? ☐ - Yes ☐ - No Please comment:

The check box question of this item resulted in the following information:

1.5.1) Did they occur on the same type of generator?



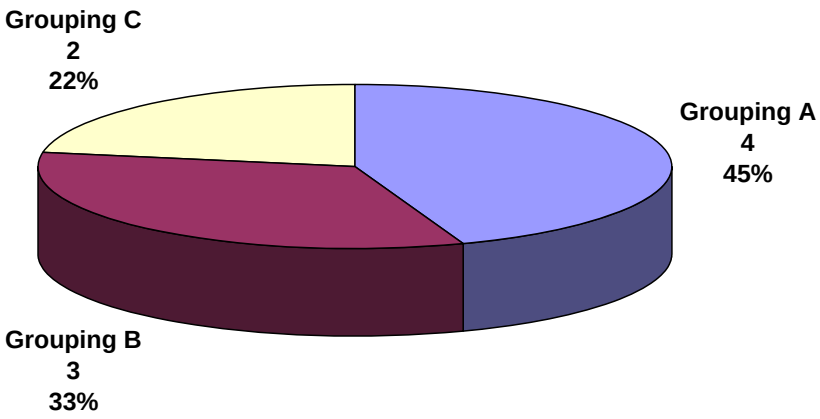
This survey has 18 Blank answers – not considered in the graph.

[Back to Index] [Go to Annex]

Open question analysis results (please comment):
The survey of the received additional comments made with the corresponding categorization showed the following result:

1.5.1) Did they occur on the same type of generator? Please comment:		
Grouping A	Different type of machines	4
Grouping B	Similar type of machines	3
Grouping C	Only one accident to report	2
Grouping D	Answer does not match the subject asked (not considered for the graphic)	2
	Total of answered questions	**11**

1.5.1) Did they occur on the same type of generator? Please comment:



This survey has 2 “Answer does not match the subject asked” answers – not considered in the graph.

The categorization shows the distribution of the comments given for different generators type – Grouping A (comment example: "*Both machines and causes were different, but they evolute to fire*.") and equal type of generators – Grouping B (comment example: "*The fires occurred on the same 2 unit power station, the generators are of identical design.*"). For more comments please refer to the annex.

[Back to Index] [Go to Annex]

D 1.5.1.1 -

1.5.1.1) What was the reason for the fire to start? Please tick the relevant box indicating the trigger factor. If you have experienced more than one fire in not least than the last 20 years (*) please copy the following table and fill it for each separate fire occurrence (please indicate the corresponding fire years).

The work made with a questionnaire imposes some limitations on the indication of more than one example; (*) in order to give more freedom for the indication of multiple examples an additional table was issued (*Form for multiple machines*). The results below show the compilation of the contributions given on the original questionnaire plus those given in the additional tables. A special compilation table was issued to get the consolidated results given bellow. This table passed to be the source for the comments to the items below. This consolidated results allowed also for a deep analysis of the given additional explanations considering their consistency towards the indicated examples. The additional explanations should address these examples to be consistent with the survey.

The time limit for this part of the fire examples survey was also discussed; there are many different situations considering the size of the involved companies. For a company that has a great quantity of generating stations and hundreds of generating units the survey work becomes a difficult task if the time frame would look far in the past – therefore a time frame of 20 years initially defined. On the other hand other companies have examples that fall over this limit, it means that are older that 20 years. Being so the time frame was defined as "at least 20 years" (but not limited to) and all examples were accepted in spite of their age.

For this item a special compilation table was made including the detailed questions; and the analysis of the corresponding check box questions resulted as follows:

Detailed question	Answers "Yes"
1.5.1.1.1) Electrical Fault in the stator winding	39
1.5.1.1.2) Electrical fault in the rotor winding	8
1.5.1.1.3) Electrical fault in the exciter housing	2
1.5.1.1.4) Mechanical Fault in bearings	5
1.5.1.1.5) Other Mechanical faults	4
1.5.1.1.6) Any other?	6

The great majority of reported accidents were caused by "Electrical faults in the Stator Windings". Additional explanations were given to each detailed question; being so some of them are shown below. Not all received comments did allow an analysis by categorization, but the original issues of the given comments may be seen on the annex. All they complement the question: "What was the reason for the fire to start?"

[Back to Index] [Go to Annex]

D 1.5.1.1.1 -

1.5.1.1.1) Electrical Fault in the stator winding ☐ - Yes ☐ - No Additional information:

After the consideration of the information received with the “form for multiple machines” the check box questions analysis of the original questionnaire is superseded. The results of the statistic of the item 1.5.1.1 become the valid ones. This consideration applies to the next items up to the item 1.5.1.1.6.

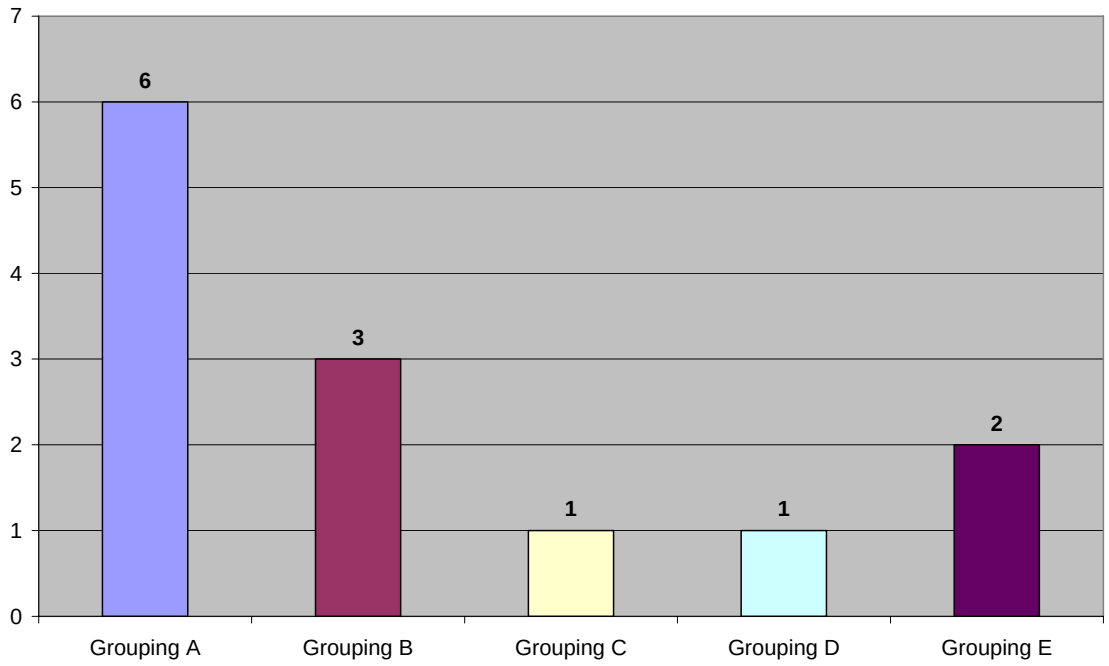
Closed questions result (check-box): from the 64 reported accidents 39 were caused by electric fault in the stator winding.

[Back to Index] [Go to Annex]

Open question analysis results (additional explanations):
The question 1.5.1 indicated that 20 companies informed that they had fire in generators. Many of them gave information for multiple accidents in their power plants. In this case we got 13 additional explanations and in 26 cases an additional explanation was not indicated, these later are not interesting for the present study.

All given additional explanations after the proper consistency screening was made were consolidated in the table 1.5.1.1 and then transposed back to this item to profit from the information received.

1.5.1.1.1) Electrical Fault in the stator winding. Additional information:		
Grouping A	Phase to phase faults	6
Grouping B	Phase to ground faults	3
Grouping C	Isolation breakdown-did not specify fault type	1
Grouping D	Failure in flexible connection	1
Grouping E	Failure in soft soldering	2
Grouping F	(Answer does not match the subject asked) - Not indicated (not considered for the graphic)	26
	Total of answered questions	**35**



The phase to phase faults are more frequent according to the table above. Here one example of the received additional comments: “*All fires have been the results of defects that have developed into phase to phase faults (lot of energy able to be feed into fault). Never seen a fire result from a straight earth fault.*”

[Back to Index] [Go to Annex]

D 1.5.1.1.2 -

1.5.1.1.2) Electrical fault in the rotor winding ☐ - Yes ☐ - No

Additional information:

Closed questions result (check-box): from the 64 reported accidents 08 were caused by electric fault in the rotor winding.

[Back to Index] [Go to Annex]

Open question analysis results (additional explanations):
The 02 consistent answers received on the original questionnaire did not allow a categorized survey, but two of these additional explanations recalled for: "*burnt flexible connection*".

As already explained in order for the given additional explanations to be consistent they have to address to a corresponding item of one correspondent given example. The additional explanations that did not fulfil this condition could not be taken in to consideration. As one example of such non considered additional explanations we can mention the following one given by the company from New Zealand coded as EMP015: "*Have seen a pole to pole connection vaporize and while there was considerable arc splatter there was no fire*". Anyhow this is an interesting contribution though.

[Back to Index] [Go to Annex]

D 1.5.1.1.3 -

1.5.1.1.3) Electrical fault in the exciter housing ☐ - Yes ☐ - No Additional information:

Closed questions result (check-box): from the 64 reported accidents 02 were caused by electric fault in the rotor winding.

[Back to Index] [Go to Annex]

Open question analysis results (additional explanations):
In this case one consistent additional explanation was given, and it was the following: "*Unit had CO2 generator fire suppression which did not cover the exciter housing directly. CO2 was not released and when fault was cleared fire went out."*

Also in this case there were additional explanations that could not be considered due to lack of consistency, it means they were not indicated in the corresponding check box question. We reproduce them for record purposes. The first was given by the company from New Zealand coded as EMP015: "*Have seen a couple of slipring catherine wheels (the traditional name for a spinning firework) as the result of carbon brush failures but no fire as the result*". The other came also from New Zealand, company coded as EMP033 and call for: "*Excitation connections to the generator failed causing the leads to 'flap' free and shear off a large proportion of the end windings resulting in a generator fire.*"

[Back to Index] [Go to Annex]

D 1.5.1.1.4 -

1.5.1.1.4) Mechanical Fault in bearings ☐ - Yes ☐ - No Additional information:

Closed questions result (check-box): from the 64 reported accidents 05 were caused by Mechanical Fault in bearings.

[Back to Index] [Go to Annex]

Open question analysis results (additional explanations):

The 03 consistent answers received did not allow a categorized survey, but one of these additional explanations, Given by a Mexican company coded as EMP012, recalled for: "*Failure on the bearing cooling system, causing the stator to be wet which caused a fault between phases..*"; which in fact resulted in a consequential winding problem.

In this particular case we have an interesting example given by a Brazilian company coded as EMP58 that inserted one comment to each detailed item, but all of them were interconnected and deflagrated by the following situation: "*All those damages has began after oil circulation failure of the turbine thrust bearing. The main circuit breaker hasn't opened after relay's high temperature metal operation.* " Since the starting point is the relevant one for this analysis the others could not be considered.

[Back to Index] [Go to Annex]

D 1.5.1.1.5 -

1.5.1.1.5) Other Mechanical faults ☐ - Yes ☐ - No Additional information:

Closed questions result (check-box): from the 64 reported accidents 04 were caused by Other Mechanical faults.

[Back to Index] [Go to Annex]

Open question analysis results (additional explanations):
The 04 consistent answers received did not allow a categorized survey, but one of these additional explanations recalled for: "*An item of steel was left behind in the generator enclosure following routine maintenance. The item caused an electrical fault in the stator, resulting in a generator fire.*" The others can be seen on the table 1.5.1.1.5 in the annex.

[Back to Index] [Go to Annex]

D 1.5.1.1.6 -

1.5.1.1.6) Any other? ☐ - Yes ☐ - No Additional information:

Closed questions result (check-box): from the 64 reported accidents 06 were caused by "any other reason".

[Back to Index] [Go to Annex]

Open question analysis results (additional explanations):
The 03 consistent answers received did not allow a categorized survey, but one of these additional explanations recalled for: "*Generator disconnect operation under load propagating fire inside the generator housing*".

Also in this case there were additional explanations that could not be considered due to lack of consistency. We reproduce them for record purposes. The first was given by the company from Poland coded as EMP053: "*Broken mechanical parts*". From the Macedonian company coded EMP027 we received: "*Generator 1: the insulation part of rotor pole was broken Generator 2: Mechanical part of bolt from lubrication system was broken and fall inside the generator during the testing of generator for start up after rehabilitation of lubrication system*". From the Brazilian company EMP045 came: "*The attrition between electrically passive components of the rotor and the stator generated heat that evolved for fire (heat + smoke)*". And finally from the Mexican company EMP012 we received: "*A machine switch failure caused circulating currents in the rotor; this increased the temperature and set fire to the fiberglass air deflection covers, causing a generator fire*".

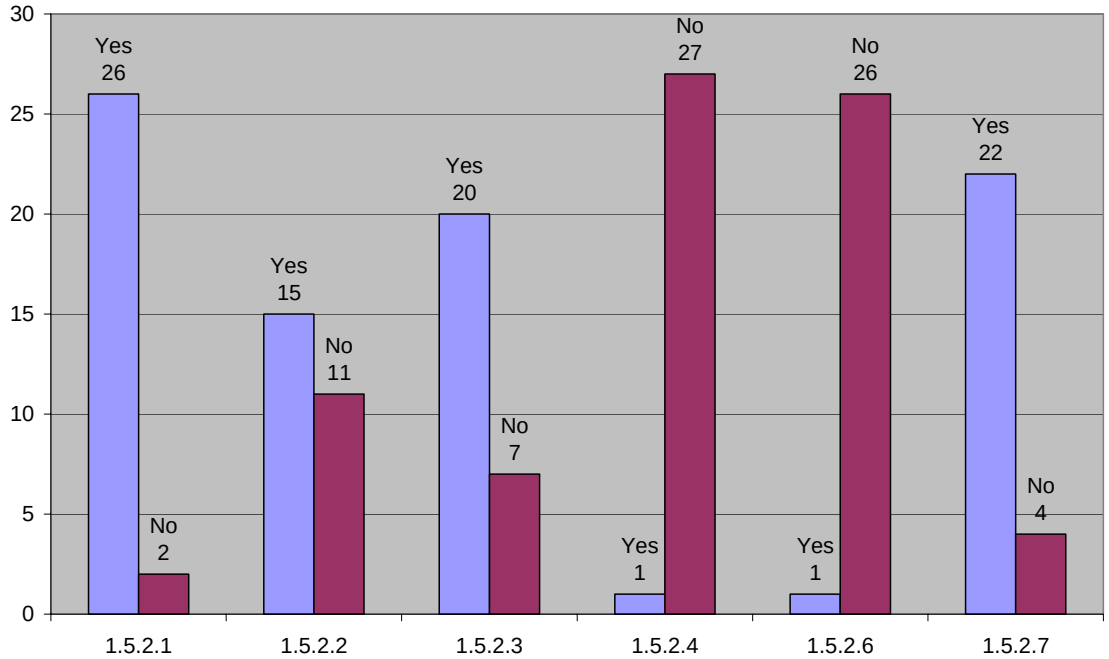
[Back to Index] [Go to Annex]

D 1.5.2 -

1.5.2) Please provide the following information on the units where fires occurred in not least than the last twenty years. If you have experienced more than one fire over the time your answer is covering, copy the following table and fill it for each separate fire occurrence (please specify the time span or the occurrence years).

Also for this question a special compilation table, including information given on the "form for multiple machines", was issued in order to collect data and allow a comparative study of the detailed questions that are part of this item and the analysis of the corresponding check box questions resulted as follows:

Detailed question	Answer "Yes"	Answer "No"
1.5.2.1) Was the unit equipped with fire protection equipment?	26	2
1.5.2.2) Did the fire protection system work according to the design specification?	15	11
1.5.2.3) Was the fire extinguished solely by the installed generator fire protection system without any additional external help?	20	7
1.5.2.4) Did the fire spread outside the generator?	1	27
1.5.2.5) Give a brief description of the damage to the generator and surrounding:	open	question
1.5.2.6) Were there any direct or indirect fatalities as a result of the fire started in the generator?	1	26
1.5.2.7) Was the fire protection designed to trigger automatically in an event of a fire or/and heat detection?	22	4



This graph gives a good view of the proportion of each question involved in the item 1.5.2. The question 1.5.2.5 does not appear in the graphic because it is an open question that will be discussed below.

According to some time indication received it is possible to say that the reported fire accidents of the 64 generators did occur between 1980 and 2001.

These detailed questions are specific and the result of each one of them is stated below. The answers are basically those given on the original questionnaire added to the few information that were given by using the “form for multiple machines”.

The following questions are those that implied in additional explanations for the reported accidents (the others are pure check-box questions and their analysis is statistical), a brief comment to the check box questions was also issued:

[Back to Index] [Go to Annex]

D 1.5.2.1 -

1.5.2.1) Was the unit equipped with fire protection equipment? ☐ - Yes ☐ - No If Yes, what is the extinguishing media? (Eg. CO_2, water, etc). If the media is chemical, please give the name.

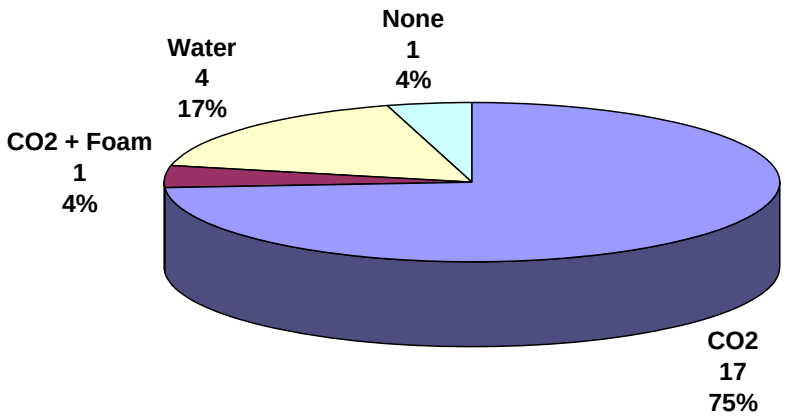
Closed questions result (check-box): as stated in the table above we had Yes= 26 and No= 02 thus giving a big majority of generator wit GFP installed.

[Back to Index] [Go to Annex]

Open question analysis results (if Yes, what is the extinguishing media?):
The additional information given, regarding the extinguishing media used by the installed GFP allowed the analysis with categorization, as follows:

1.5.2.1) Was the unit equipped with fire protection equipment? If Yes, what is the extinguishing media? (Eg. CO_2, water, etc). If the media is chemical, please give the name.		
Grouping A	CO2	17
Grouping B	CO2 + Foam	1
Grouping C	Water	4
Grouping D	None	1
	Total of answered questions	**18**

1.5.2.1) Was the unit equipped with fire protection equipment? If Yes, what is the extinguishing media?



This question’s result is in line with other questions in this work and shows that among the companies that answered the questionnaire the majority uses CO_2 (Grouping A) as extinguishing media. This was true also for this question that pursued additional information of the reported fire accidents on generators.

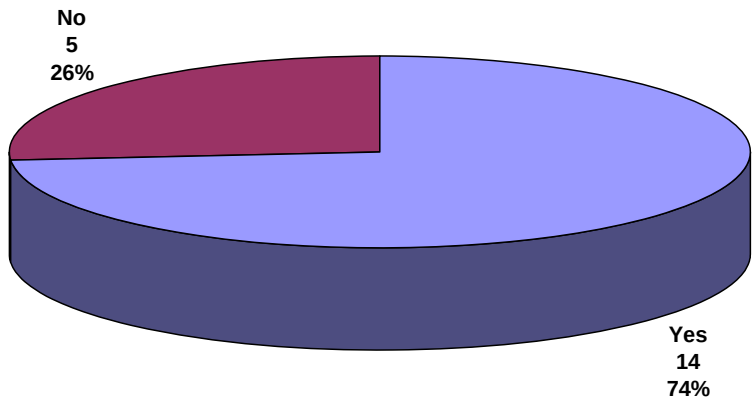
[Back to Index] [Go to Annex]

D 1.5.2.2 -

1.5.2.2) Did the fire protection system work according to the design specification? ☐ - Yes ☐ - No

Closed questions result (check-box): giving a big majority of generators wit GFP installed.

1.5.2.2 - Did the fire protection system work according to the design specification?



This survey has 16 Blank answers – not considered in the graph.

[Back to Index] [Go to Annex]

Brief comment:
This case shows a fairly high amount of answers telling that the fire protection system did not work according to the design specification (26%). The important conclusion in this case is that the reasons for this non-compliance shall be determined in order to improve the GFP reliability from case to case.

D 1.5.2.3 -

1.5.2.3) Was the fire extinguished solely by the installed generator fire protection system without any additional external help? ☐ - Yes ☐ - No

Closed questions result (check-box): as stated in the table above we had Yes= 20 and No= 07 thus giving a big majority of generators wit GFP installed.

Brief comment: in this case the majority of the fires were extinguished solely by the installed generator fire protection system without any additional external help. In 07 examples help from third sources was required.

Although no additional information was requested by this check-box question we got an statement given by the New Zealand's company coded as EMP015 that indicated "Yes" for the two given examples in this question (on the question before it was informed that the GFP did not work according to the design). The statement is: "*The generator fire protection did not really play any part in extinguishing of the fires. The fires basically self extinguished once the energy source was removed by the generator electrical*

protection relays and by the windage as the machine shut down. However the windage tends to drag the fire around the stator so damage is more extensive than if water could have been discharged"

[Back to Index] [Go to Annex]

D 1.5.2.4 -

1.5.2.4) Did the fire spread outside the generator? ☐ - Yes ☐ - No

Closed questions result (check-box): as stated in the table above we had Yes= 01 and No= 27 thus giving a big majority of generators wit GFP installed.

Brief comment: here we have a good result because only in one case the fire did the fire spread outside the generator. Such a spreading can involve other components of the power plant in to the fire leading to a major catastrophe.

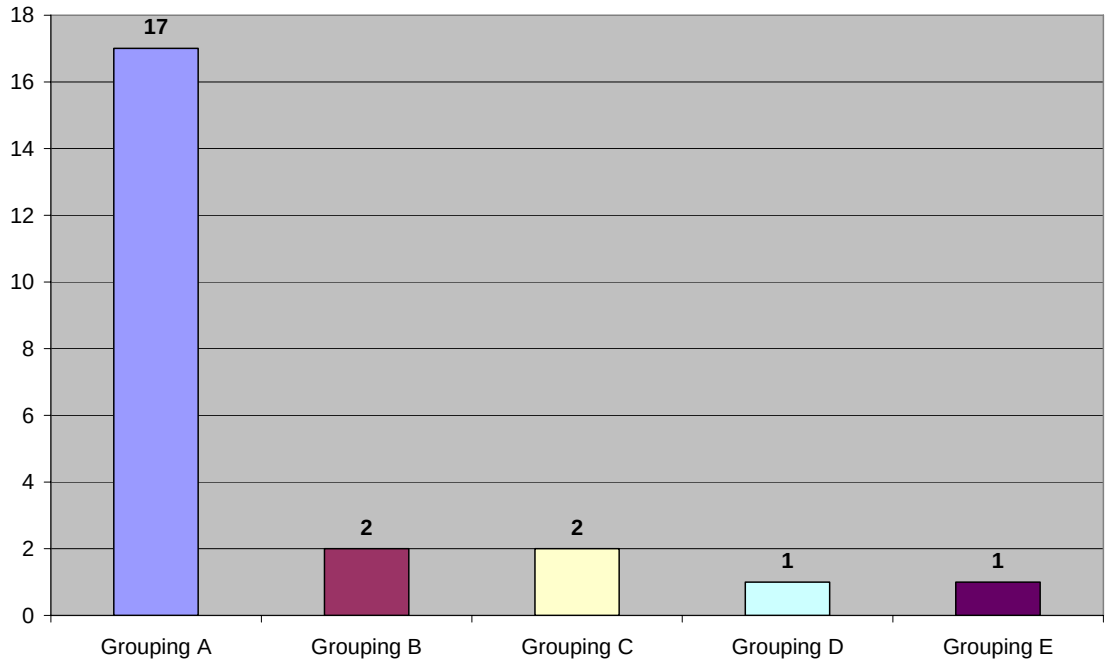
[Back to Index] [Go to Annex]

D 1.5.2.5 -

1.5.2.5) Give a brief description of the damage to the generator and surrounding:

This is a pure open question and the contributions given with the "form for multiple machines" added new information to that received with the initial questionnaire. A new summary table was issued for this item which was taken for the categorization study that gave the result below:

1.5.2.5) Electrical Fault in the stator winding. Additional information:		
Grouping A	Stator winding damage	17
Grouping B	Excitation slip rings and/or brushes damage	2
Grouping C	Rotor and stator winding damage	2
Grouping D	Little damage but great cleaning works.	1
Grouping E	Fire remained contained inside the generator housing	1
Grouping F	Answer does not match the subject asked (not considered for the graphic)	1
	Total of additional information given	**24**



The 17 additional information reaching 70,8% of the total that point to stator winding damage (Grouping A) show that this is the most critical part of the machine and deserves special attention when the GFP's design is made.

Very reach comments to this issue were given and some of these were selected to be reproduced as follows.

Grouping A: the contribution of the company from New Zealand coded EMP015: "*In all cases the fire was contained within the generator winding enclosure. The most recent case (7yrs ago) damage confined to a section of the bottom end winding - copper lost and fire damage to a little under a third of circumference. The next case (9yrs ago) there was significant copper lost and fire damage to the top end winding area of the machine, extending approx 1/2 way around the stator. Cases 3 and 4 (12 -14 yrs ago) there was some copper lost in phase lead and fire damage to approximately a third of the top end winding. Other experience is outside 20 year window.*" For the sake of time identification this contribution was received in 2008.

Grouping B: here the contribution from the German company coded as EMP049, that reported the occurrence of: "*Contamination, damages of coal brushes.*"

Grouping C: the Brazilian company coded as EMP058 reported the following: "*The rotor totally damaged and the stator partial damaged. The rotor was fixed definitively and the stator was partially fixed until it was possible to exchange it for a new one.*"

Grouping D: the company from New Zealand coded EMP033 reported that: "*Damage was minimal, but required a significant clean up effort inside the generator enclosure.*"

Grouping E: the Canadian company coded EMP036 about damage to the generator and surrounding" reported that: "*none - contained within enclosure*" (probably their focus remained on damages on the surroundings).

The complete set of additional explanations given also for the item 1.5.2.5 can be seem on the correspondent annex, as well as on the original questionnaires answers received.

[Back to Index] [Go to Annex]

D 1.5.2.6 - **Were there any direct or indirect fatalities as a result of the fire started in the generator?**

1.5.2.6) Were there any direct or indirect fatalities as a result of the fire started in the generator?
☐ - Yes ☐ - No

Closed questions result (check-box): as stated in the table above we had Yes= 01 and No= 26.

Brief comment: here we have a good result because only in one case fatality occurred. This indicates that the Users involved show a good degree of operational safety in their plants considering fire accidents.

[Back to Index] [Go to Annex]

D 1.5.2.7 - **Was the fire protection designed to trigger automatically in an event of a fire or/and heat detection?**

1.5.2.7) Was the fire protection designed to trigger automatically in an event of a fire or/and heat detection?
☐ - Yes ☐ - No

Closed questions result (check-box): as stated in the table above we had Yes= 22 and No= 04.

Brief comment: the question of GFP release method asked with this question was also discussed in other questions that go deeper in this operational definition. According to this first approach the majority of Users do have automatic release.

[Back to Index] [Go to Annex]

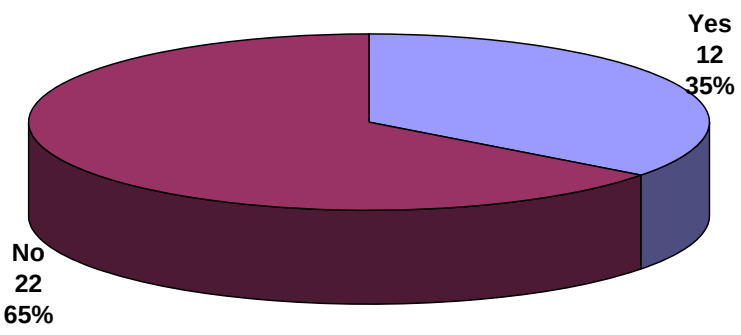
D 1.6 -

1.6) Do you have different types of fire protection systems within the generators installed in your power plants?
☐ - Yes ☐ - No

This question starts a survey that is complemented by the questions 1.6.1 to 1.6.4. The answer to the first part, 1.6, defined answers from the questions 1.6.1 and 1.6.2.

The answers for the question 1.6 showed the following results:

1.6 - Do you have different types of fire protection systems within the generators installed in your power plants?



This survey has 1 Blank answer – not considered in the graph.

The majority of the answers showed that the common practice is to have a single protection scheme, but when Users have generators of different generations of insulation (bitumen or epoxy based), or different type of location (open air or cavern) there are different types and sometimes it is a transition period.

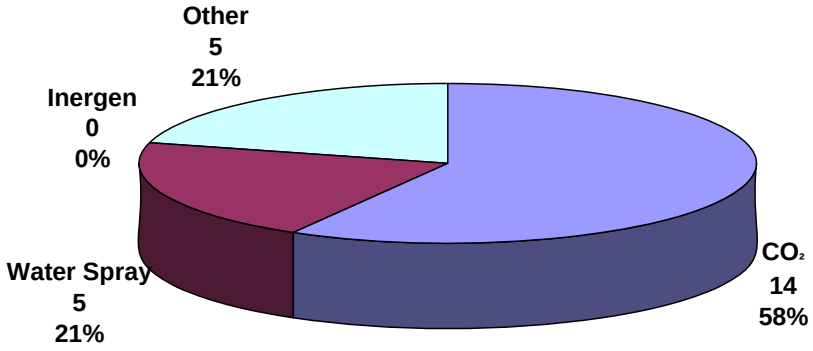
[Back to Index] [Go to Annex]

D 1.6.1 -

1.6.1) If no, please indicate which is your sole fire protection system: ☐ - CO_2 ☐ - Water Spray ☐ - Inergen ☐ - Other If other please indicate here which:

This question was meant for those Users that have only one GFP system type. There was a choice between CO2, Water, Inergen (inert gas) or other, where other could be "no GFP installed". The result was the following:

1.6.1) If no, please indicate which is your sole fire protection system:



This survey has 5 Blank answers – not considered in the graph.

Here the 49% of answers indicating the sole use of CO2 is coherent with other questions showing the broad use of this extinguishing media.

[Back to Index] [Go to Annex]

Open question analysis results (If other please indicate here which):
But there is an open question related to "others". This open question got the 05 possible answers but no categorized study was required in this case.

In the sequence some answers are reproduced. One User from Australia, coded as EMP039 informed the following: "*CO_2 has been removed and water based suppression is being installed on selected units. Water based fire suppression currently being installed on the following Hydro generators Tumut 1 generators (4x 82.4MW), Tumut 2*

generators (4x 71.6MW). Planning to install water based fire suppression at Tumut 3 (6x 250MW), Murray 1 (10x 95MW), Murray 2 (4x 138MW) & Guthega (2x 30MW)."
The German User coded EMP048 informed that he uses: "*NO_2 gas*."
The Japanese companies rely on dry chemical powder (extinguishers) as the User coded EMP028 commented: "*Dry-chemical extinguisher in portable execution for manual application (no fix system installation). We have over 200 hydro generators. Those capacities are about 100kW to 300,000kW."* This is a interesting information because in no other country this method is used for such large units; moreover the use in form of extinguisher is quite peculiar.

[Back to Index] [Go to Annex]

D 1.6.2 -

1.6.2) If yes, please indicate which are you're the different fire protection systems you have installed:
☐ - CO_2 - how many units?
☐ - Water Spray - how many units?
☐ - Inergen - how many units?
☐ - Other - how many units?
If other please indicate here which:

For this question we had many alternatives with additional information. Not only the type of the system used (CO_2, Water, Inergen or Other) but also the quantity of protected units. The way to solve the complexity of this question and to show the answer was in form of a composed table as follows:

Company code/country	CO_2	Water Spray	Inergen	Other units number	Others description**
EMP005 - SUI	blank	blank	blank	blank	blank
EMP006 - SUI	15	blank	6	blank	blank
EMP015 - NZL	4	8	blank	blank	blank
EMP019 - SWE	no actual figure available too many	blank	blank	no quantity indication	Relay protection + VESDA
EMP021 - CHN	3	Almost all genera--tor in China applies water spray.	blank	blank	blank
EMP026 - SWE	1	blank	blank	blank	do not match with the question
EMP031 - MEX	6	2	blank	no quantity indication	Foam
EMP032 - CAN	2	78	blank	blank	blank
EMP033 - NZL	32	blank	7	blank	blank
EMP056 - SUI	14	1	38	1	N2
EMP054 - AUT	22	blank	blank	246	4 Dry fire fighting pipe + 242 without GFP
EMP051 - AUT	2	2		no quantity indication	All other units have no GFP
Totals*	101	91	51		

(*) About the quantity of protected units the numbers indicated on the bottom line of the table above are the sum of the indicated quantities; we call the attention to the fact that the real number is not known because of remarks as "*almost all the generator in China apply water spray*" and the lack of quantity indication by other involved Users.

We point out the use of Inergen as extinguishing media, an inert gas mixture that imposes no harm to operators and is a GREEN media, leaves no residue, do not require special extraction facilities, and do not impose any harm to the equipment either; all this being a proven extinction system.

(**) we reproduce here some of the complete descriptions given to the question "if other please indicate here which". The Swedish User coded EMP019 informed that: "*On some of our bitumen windings we have CO_2 fire protection. We are trying to take these away and replace them with high quality relay protection sometimes combined with smoke sniffers. No water or Inergen or others if these sniffers don't count. Our company has 241 HPP so it is difficult to tell the real number of CO_2 systems but they are fewer all the time and there are no CO_2 systems or others when the winding is of epoxy type.*" Also referring to the high degree of difficulty to give detailed figures because of the great quantity of units they have we reproduce the comment stated by the Canadian User coded EMP032 as follows: "*Please note that we have 78 Hydroelectric and 2 combstion Turbines (CT Units). These two CT units are equipped with CO2 enforced by the CT supplier*". And there are many units without GFP as the Austrian User coded EMP054 informs: "*242 units have no fire protection system*." This procedure was corroborated by another Austrian User coded EMP051 that informed that he has 2 units with CO2 and 2 with water and complemented: "*All other units of our organization are NOT equipped with a fire protection system.*"

[Back to Index] [Go to Annex]

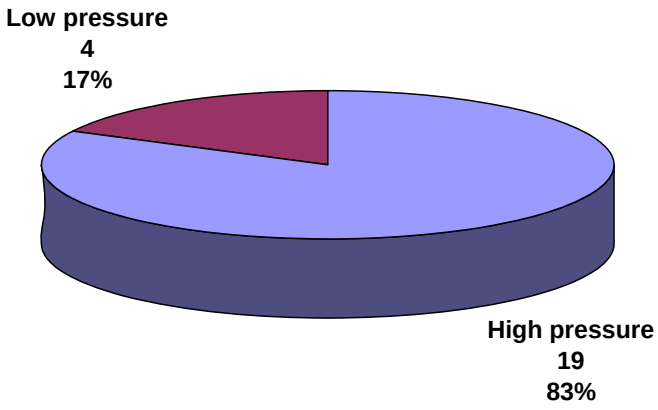
D 1.6.3 -

1.6.3) In the case of CO_2 please indicate the pressure system used: ☐ - High pressure ☐ - Low pressure Any comment on this issue?

This question was somewhat specific because some of the involved Users use only high pressure CO_2 systems and even do not have information about the low pressure system.

The result of this question can be seen below:

1.6.3) In the case of CO_2 please indicate the pressure system used:



This survey has 12 Blank answers – not considered in the graph.

[Back to Index] [Go to Annex]

Open question analysis results (any comment on this issue):
No categorized survey was applicable in this case. The majority uses high pressure system, as for example the User from New Zealand, coded EMP033, which informed: "*High pressure CO_2 systems comprising CO_2 cylinder banks*." Some companies use both systems, as informed the Brazilian company coded EMP016 that reported: "*We use both, high and low pressure systems in different power plants.*" Two companies informed that they intend to remove the CO2 systems, here the statement of a User from New Zealand, coded EMP015: "*Will eventually be remove and replaced with a water fogging system, but not a high priority at this stage. We have removed the CO_2 from the other station because it released more into the lower galleries than into the machine enclosure and posed a signification risk to staff on the station, if working at lower levels when the CO2 was discharged.*"

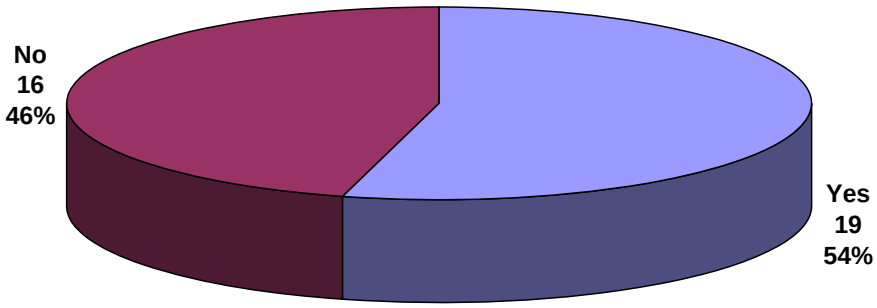
[Back to Index] [Go to Annex]

D 1.6.4 -

1.6.4) Do you have generators with open circuit ventilation? ☐ - Yes ☐ - No If yes, which kind of fire protection, if any, do they have?

This question was stated due to the fact that open circuit generators usually need special care in the design and application of GFP. The result of this survey

1.6.4) Do you have generators with open circuit ventilation?



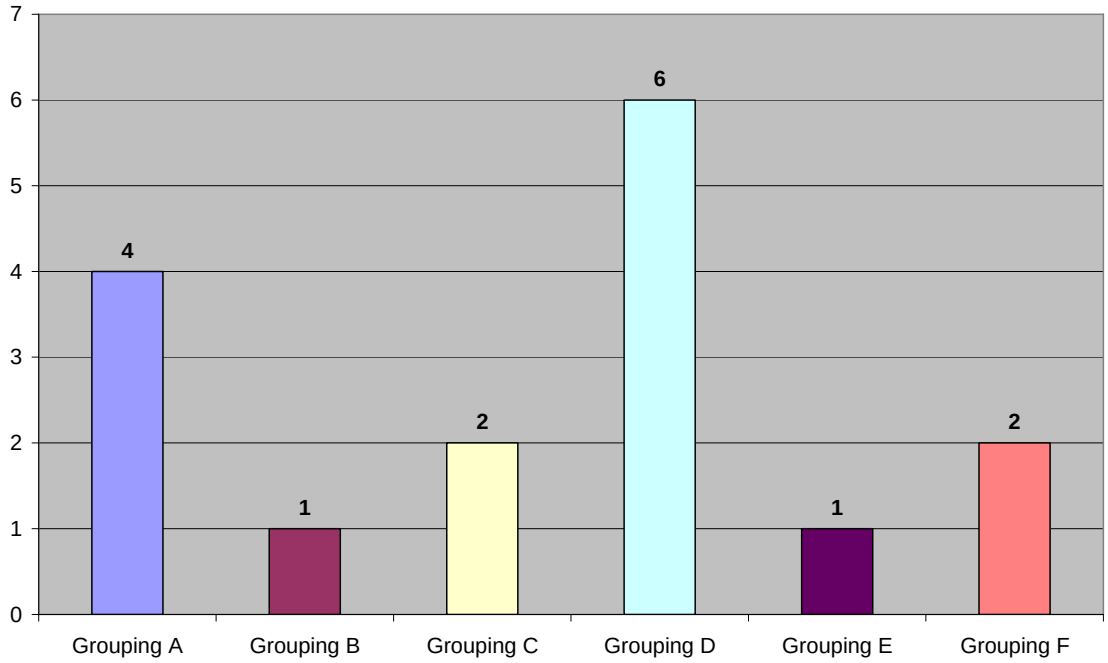
The quantity of Users that have open circuit ventilation generators amounts to 54% of the involved companies.

[Back to Index] [Go to Annex]

Open question analysis results (If yes, which kind of fire protection, if any, do they have?):
A complement question was made asking if yes, which kind of fire protection, if any, they have. A categorized study revealed the following result:

1.6.4) Do you have generators with open circuit ventilation? If yes, which kind of fire protection, if any, do they have?		
Grouping A	CO2	4

Grouping B	Dry Powder	1
Grouping C	CO2 and other - Foam or Inergen	2
Grouping D	No protection available or none generator with open circuit ventilation	6
Grouping E	NO2	1
Grouping F	Water spay	2
Grouping G	Answer does not match the subject asked (not considered for the graphic)	1
	Total of answered questions	**17**



The no protection alternative appears with the grater number of examples (6), CO2 comes next (4), then with 2 Water Spray and the interesting application of Foam in generator fire protection.

The application of CO2 in such type of machines requires additional components as the User from Macedonia, coded EMP027, commented: "*We have two Generators with power 9,5 MVA and they are in operation since 1959. The cooling system of the generator is open circuit ventilation with air. They have installed stationary fire protection with CO_2 under the high pressure. The design for fire protection is to close inlet and outlet gate for cooling air and activate CO2 if fire will be detected in the generator by relay protection.*"

[Back to Index] [Go to Annex]

D 1.7 -

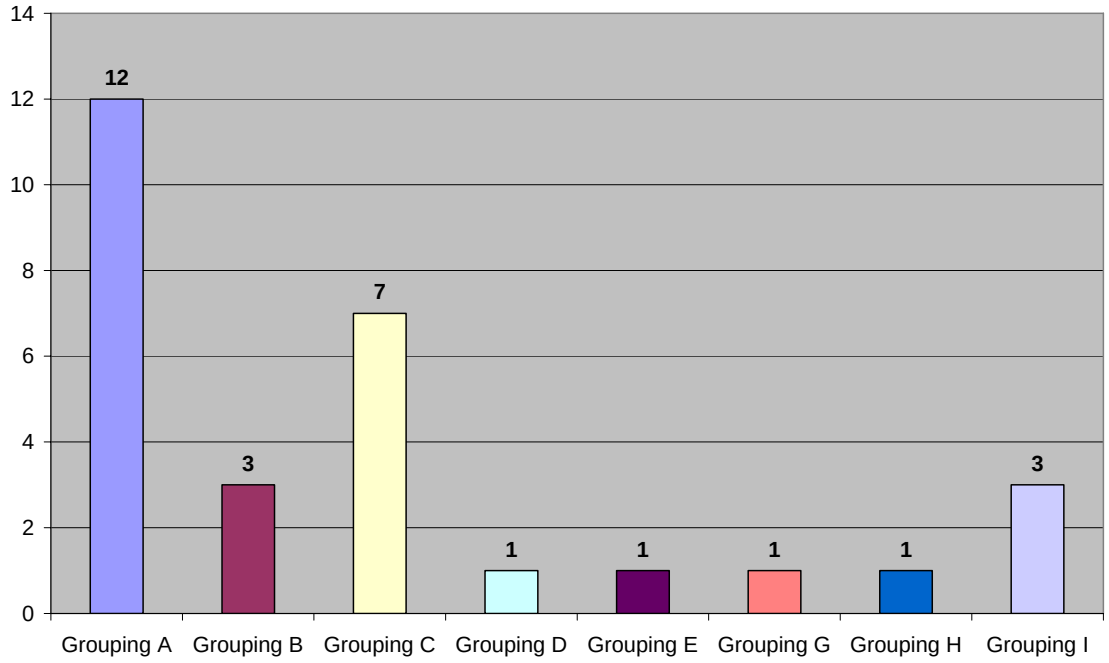
1.7) In your opinion/experience what is the most efficient fire extinguishing media?

This block, composed by four questions deals with questions directly connected to the extinguishing medias; most efficient, harmful to machines and human health and environmental concerns.

Staring with the question 1.7 that is a pure open question and the quantity of answers allowed the categorized study and resulted in the graphic below:

1.7) In your opinion/experience what is the most efficient fire extinguishing media?

Grouping A	CO2	12
Grouping B	Inergen (inert gas)	3
Grouping C	Water	7
Grouping D	Avoid fire begin (prevention)	1
Grouping E	Depends on type of application	1
Grouping F	Blank (no answer) - (not considered for the graphic)	6
Grouping G	Fire Extinguisher	1
Grouping H	Foam extinguisher	1
Grouping I	No experience or no opinion	3
	Total of answered questions	**35**



The result confirmed the preference for CO2 considered as most efficient extinguishing media by 12 Users, in second place water was indicated by 7 Users and Inergen got 3 favorable opinions (as a new media for hydro generators this is an interesting result).

The comments given can be seen on the correspondent annex. This question had 6 blank answers not considered in the graphic above.

[Back to Index] [Go to Annex]

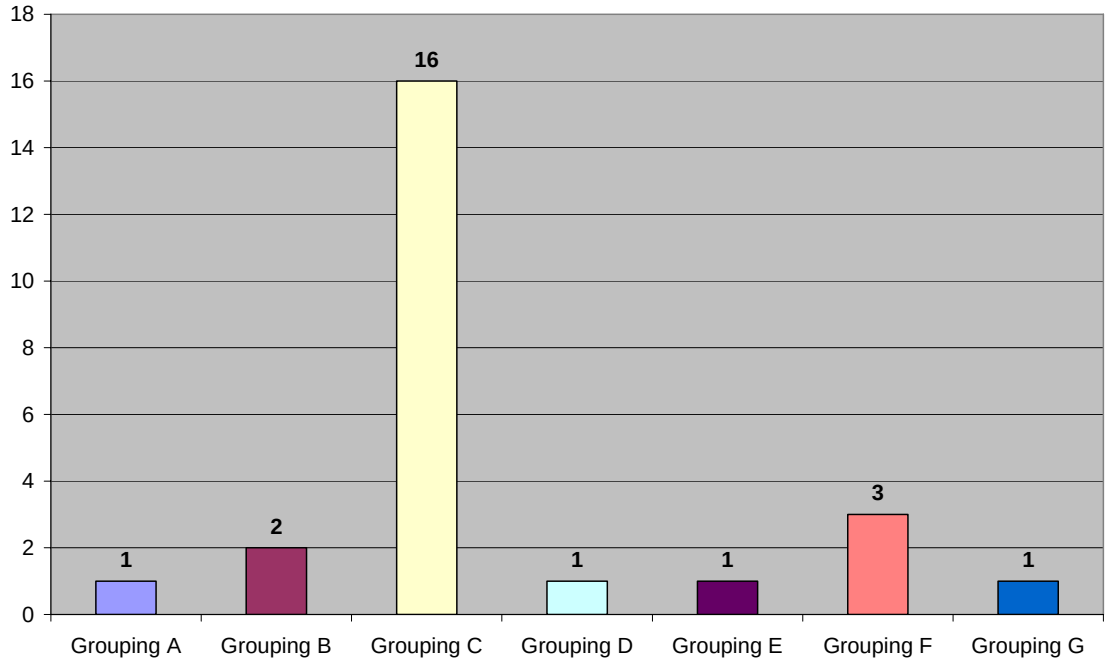
D 1.7.1 -

1.7.1) Which media is harmful to the machines?

This question was also stated as a pure open question with the following results of the categorized study:

1.7.1) Which media is harmful to the machines?		
Grouping A	CO2	1
Grouping B	Gas or Halon	2
Grouping C	Water	16
Grouping D	Gas - Water	1
Grouping E	Chemical Dust	1
Grouping F	Not defined or None	3
Grouping G	No experience or no opinion	1
Grouping H	Blank (not considered for the graphic)	10

Total of answered questions	35



A significative result shows that 16 Users consider water as being more harmful to the machines. This information is consistent with several reports received from experienced erection and maintenance people that recall problems with the refurbishment of units in which fire were extinguished with water and that show severe oxidation problems even in units allegedly protected by “special” varnish coating.

The answers can be seen in the enclosure.

[Back to Index] [Go to Annex]

D 1.7.2 -

1.7.2) Which media is harmful to the human health?

This question was also stated as a pure open question. In order to evaluate the different answers given the table below was issued:

1.7.2	Alternatives indicated for this item							
	CO2	Halon	N2	Foam	any gas	C. Powder	Nothing	Blank
EMP013-BRA								1
EMP051-AUT								1
EMP009-CHN								1
EMP026-SWE								1
EMP038-SWE								1
EMP045-BRA	1	1				1		
EMP005-SUI	1							
EMP028-JPN	1							
EMP037-RUS	1							
EMP010-CAN	1							
EMP012-MEX	1							
EMP043-JPN	1							
EMP008-BRA	1							
EMP016-BRA	1							
EMP019-SWE	1							
EMP027-MKD	1							

EMP025-BRA	1							
EMP039-AUS	1							
EMP032-CAN	1							
EMP033-NZL	1							
EMP036-CAN	1							
EMP047-SWE	1							
EMP055-USA	1							
EMP058-BRA	1							
EMP040-NOR	1	1						
EMP056-SUI	1		1					
EMP021-CHN	1							
EMP023-ESP	1							
EMP015-NZL	1				1			
EMP031-MEX	1			1				
EMP054-AUT	1	1						
EMP020-BRA	1	1						
EMP048-GER	1		1					
EMP006-SUI			1					
EMP053-POL							1	
Totals	28	4	3	1	1	1	1	5

We recall that this question was a pure open question so that the alternatives were indicated by the Users. CO2 was considered the most harmful media for the human health. This is explained by the comment issued by the Spanish User, coded as EMP023-ESP, as follows: "*CO2 is harmful to the human health because displacing of air and it is necessary to remove CO2 of stator room before the entry of personnel to the stator area.*"

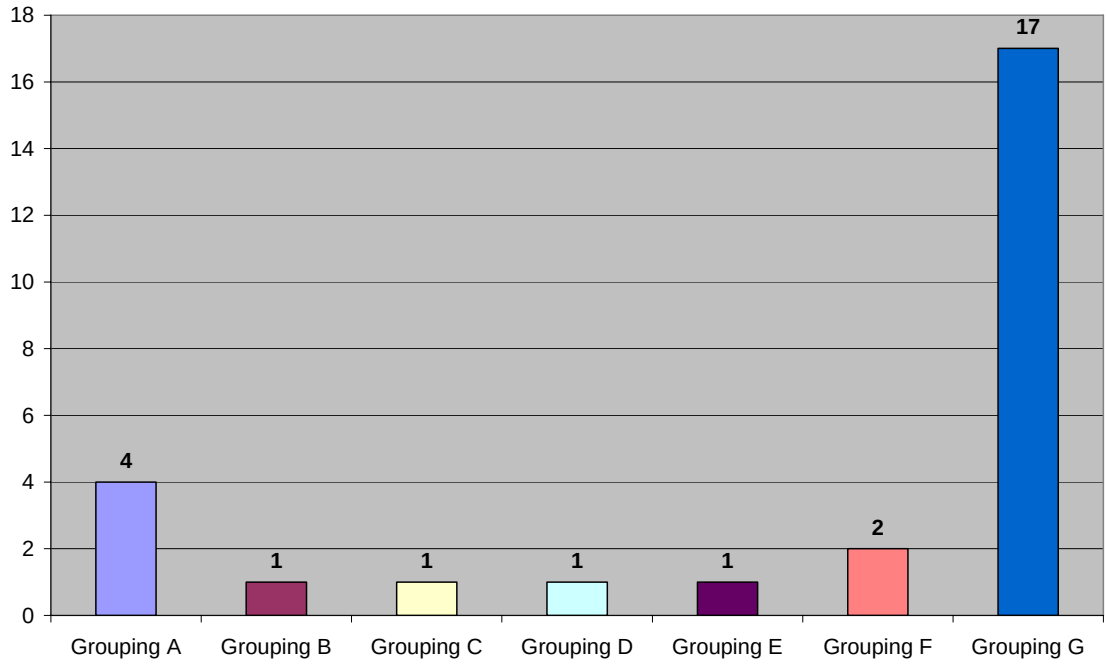
[Back to Index] [Go to Annex]

D 1.7.3 - **Is there any environmental concern bound to any media currently in use?**

1.7.3) Is there any environmental concern bound to any media currently in use?

This question was also stated as a pure open question with the following results of the categorized study:

1.7.3) Is there any environmental concern bound to any media currently in use?		
Grouping A	Yes for CO2	4
Grouping B	Yes for CO2 and Halon	1
Grouping C	Yes for FM200	1
Grouping D	Halon	1
Grouping E	Greenhouse gas - but no additional explanation given	1
Grouping F	Yes - but no additional explanation given	2
Grouping G	No concern	17
Grouping H	Blank - no answer (not considered for the graphic)	8
	Total of answered questions	**35**



For 17 Users there is no concern, but some of the given explanations did show a probable lack of information about CO_2 used as extinguishing media, as for instance the answer given by the American company coded as EMP055-USA, that wrote: "*CO_2 may have harmful effect to worldwide greenhouse warming.*" In fact the CO_2 used in fire protection is usually obtained from usual industrial processes, as for instance beer breweries, that generate CO_2 in the context of their usual industrial process. Part of this CO_2 is trapped and compressed in cylinders for use as extinguishing media. Being so this CO_2 is only liberated to the air in case of a fire accident. This fact redeemed the CO_2 used for fire combat from being considered as harmful to the environment – fact that is confirmed by many environmental institutes.

Other environmental aspect that was not raised here is the given contributions were the requirements concerning the waist water resulting from fire extinction. This water is highly contaminated and in many countries there are specific rules that require that a special piping and collect tank for this waist water is installed and that the waist water is treated before it is returned to the river.

[Back to Index] [Go to Annex]

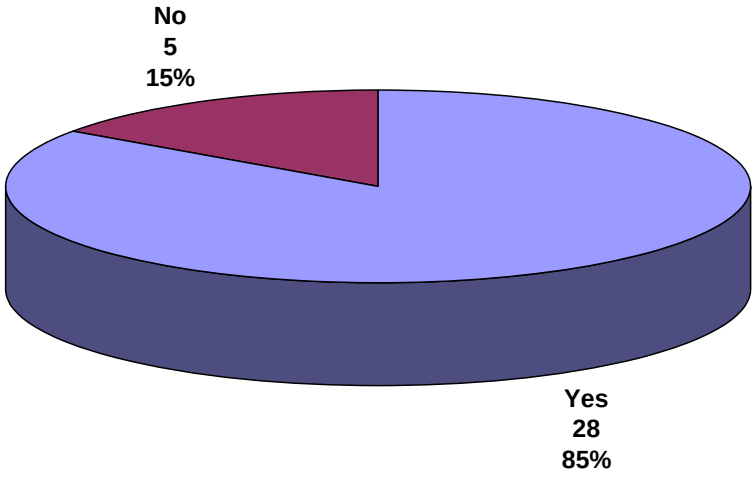
D 1.8 - **Do you specify measures to prevent accidents to personnel?**

1.8) Do you specify measures to prevent accidents to personnel? ☐ - Yes ☐ - No If yes, please specify:

This block deals with the prevention of accidents with personnel and prevention of machine damages and comprises the questions 1.8 and 1.8.1.

This item 1.8 has a check-box question and an open question to get more experience data.
Starting with the check-box question:

1.8) Do you specify measures to prevent accidents to personnel?



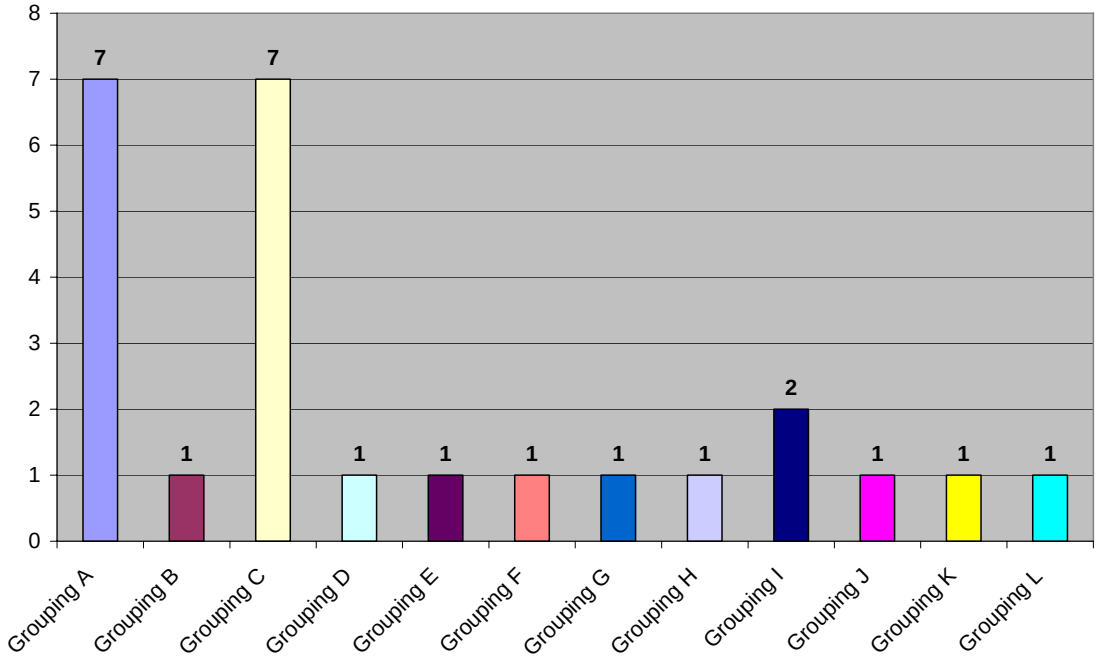
This survey has 2 Blank answers – not considered in the graph.

The majority of Users, 80%, indicated that they are concerned with accident to personnel and that specific measures are undertaken to prevent accidents.

[Back to Index] [Go to Annex]

Open question analysis results (If yes, please specify):
The open questions asking Users to specify which measures are undertaken was analyzed by a categorized study that showed the following result:

1.8) Do you specify measures to prevent accidents to personnel? If yes, please specify:		
Grouping A	People trained according to regulations, accident prevention policy	7
Grouping B	Audible warning for evacuation of the area	1
Grouping C	Automatic and manual (CO2) interlocking, disconnect system before going in to room - for inspection or maintenance	7
Grouping D	CO2 systems are not acceptable	1
Grouping E	Forbid to enter housing after CO2 discharge	1
Grouping F	Fire alarm and emergency exit lightning	1
Grouping G	Fire Door	1
Grouping H	Isolation requirements and choice of media	1
Grouping I	Forbid access to CO2 protected areas when system is activated	2
Grouping J	Eliminate CO2 systems when relay system is sufficient	1
Grouping K	Implementation of fire compartments on power plants	1
Grouping L	Planning to remove CO2	1
Grouping M	Answer does not match the subject asked (not considered for the graphic)	1
	Total of additional information given	**26**



The indications of application of personnel training according to accident prevention policies is a very positive result; as commented by the Chinese User, coded EMP021-CHN: "*All the staff working inside the plant have more knowledge which is clearly indicate in the notice and regulation. They know how to protect themselves and move in correct direction and use of the hydrant. They have well.*"

Other aspect that was pointed out is the precaution for units protected by CO_2 that appears on several of the groupings above. As an example we reproduce the comment issued by the Brazilian User coded EMP045: "*It is not allowed to get inside the housing when the fire protection system is activated; specific training programs for the Fire Brigade; creation of appropriate routes for fire escape*." Another critical moment is when the unit is undergoing maintenance works and the Polish User coded EMP053 commented the following: "*During generator overhaul mechanical stoppers are installed on CO2 valves to prevent CO2 injection into generator interior when people is working."*

The remaining comments can be seen on the corresponding annexes.

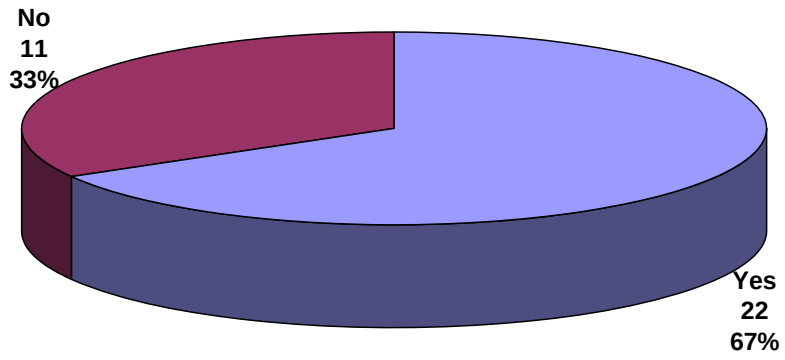
[Back to Index] [Go to Annex]

D 1.8.1 -

1.8.1) Do you specify measures to prevent damage to machine? ☐ - Yes ☐ - No If yes, please specify:

This item has a check-box question and an open question to get more experience data. Starting with the check-box question:

1.8.1 - Do you specify measures to prevent damage to machine?



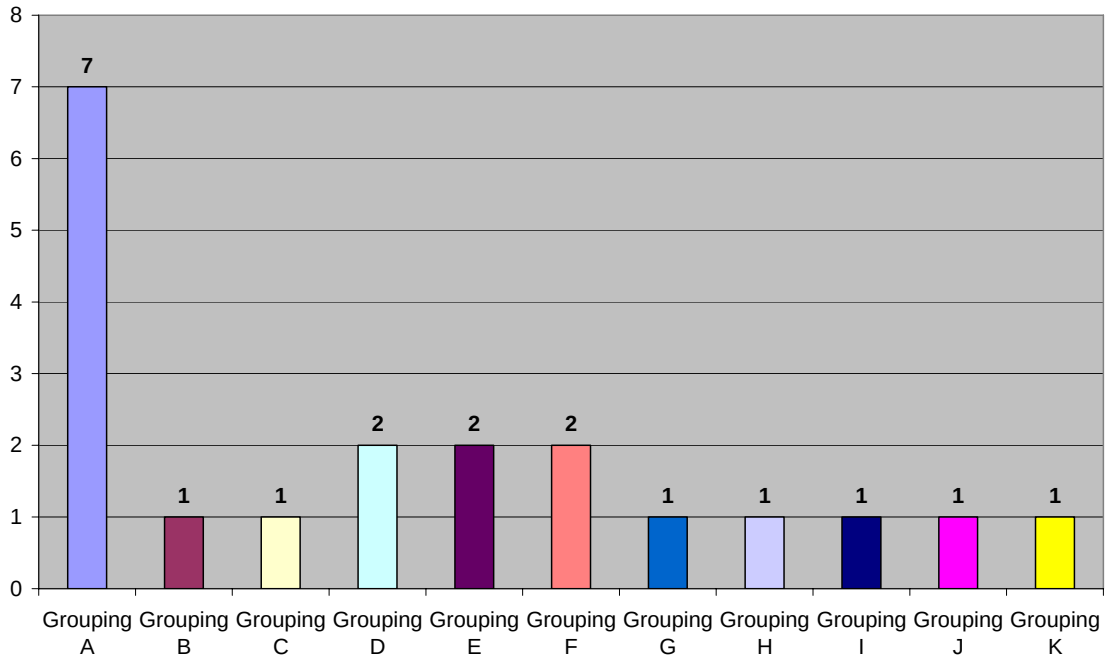
This survey has 2 Blank answers – not considered in the graph.

The result shows that the Users are also concerned about their machines situation.

[Back to Index] [Go to Annex]

Open question analysis results (If yes, please specify):
The open questions asking Users to specify which measures are undertaken was analyzed by a categorized study that showed the following result:

1.8.1) Do you specify measures to prevent damage to machine? If yes, please specify:		
Grouping A	Automatic protection, relays, release start interlocks	7
Grouping B	Fire door	1
Grouping C	Use of special detection (VESDA)	1
Grouping D	Keep CO2 sprays distant from machine components	2
Grouping E	Monitoring of machine values, temperatures, ozone levels, etc.	2
Grouping F	Following manuals	2
Grouping G	Safety prevention during maintenance	1
Grouping H	Access restriction	1
Grouping I	Inspection by external authorities	1
Grouping J	Use of non flammable material	1
Grouping K	Water extinction is not acceptable	1
Grouping L	Answer does not match the subject asked (not considered for the graphic)	2
	Total of additional information given	**22**



The total of seven answers could be categorized as “Automatic protection, relays, release start interlocks” indicating way this Users keep their units. The Brazilian User coded as EMP058 informed the following: “*All protection is done by automatic protection system independent of personnel action. Manual protection is used when the operator is sure of fire existence and system had a failure.*”

One of the given additional information recalled the use of modern aspiration type smoke detectors in hydro generators fire protection, this was the contribution of a User from New Zealand, coded EMP015, that said that they protect their units by: “*Installing VESDA detection systems and require both a VESDA level 4 activation plus a differential protection relay operation before water is actually discharged into the generator. There is a manual discharge capability, but it still requires the VESDA level four activation*.”

For the other comments please refer to the specific annex.

[Back to Index] [Go to Annex]

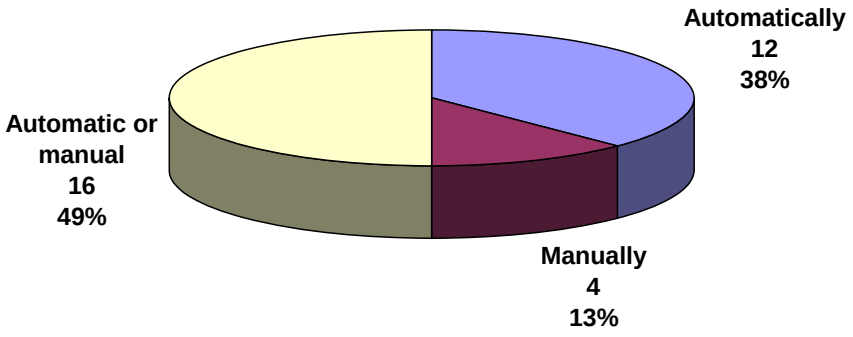
D 1.9 -

1.9) By what means is the existing generator fire extinguishing system is designed to release? ☐ Automatically ☐ Manually or ☐ Either automatic or manual. If you have different fire protection systems please repeat the answer to each different fire protection system.

This block, composed by the questions 1.9 and 1.9.1, deals with the GFP release schemes; the installed and the preferred ones.

Starting with the pure check-box question 1.9, which gave the choice between automatic release, manual or selectable both, either or, we came to the result:

1.9) By what means is the existing generator fire extinguishing system is designed to release?



This survey has 3 Blank answers – not considered in the graph.

The flexible alternative either automatic or manual got 46% of the votes. As to be expected the pure manual alternative got only 4%.

NOTE: this question was also included in the "form for multiple machines" and from the few answers received only one brought one answer with coherent values that did not interfere in the overall statistics tendency.

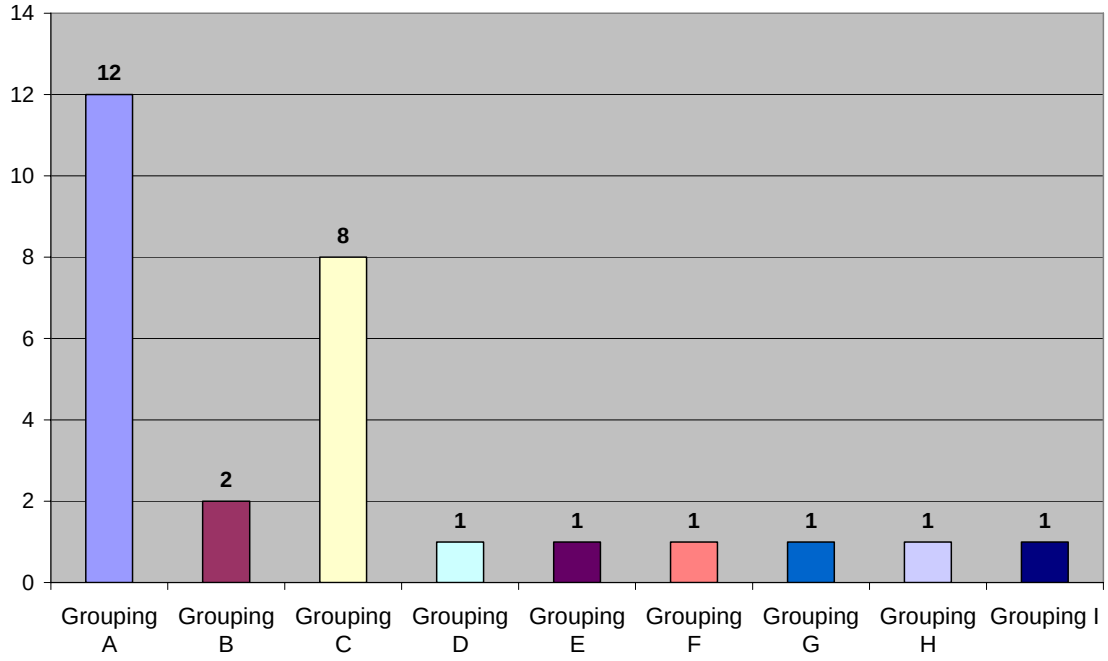
[Back to Index] [Go to Annex]

D 1.9.1 - **What is your opinion or preferred method, as to how the generator fire extinguishing system should be released?**

1.9.1) What is your opinion or preferred method, as to how the generator fire extinguishing system should be released?

This is a pure open question that resulted in the following categorized analysis:

1.9.1) What is your opinion or preferred method, as to how the generator fire extinguishing system should be released?		
Grouping A	Automatic	12
Grouping B	Manual	2
Grouping C	Automatic or manual (some with semi-automatic alternative)	8
Grouping D	If any: Automatic, provided with GFP than automatic provided that is will be de-energized when personnel in in the power station	1
Grouping E	Automatic or manual but with VESDA (smoke detector) level 4 activation	1
Grouping F	Automatic or manual but with thermal sensors interlock	1
Grouping G	Must have activated detectors and split phase operation	1
Grouping H	Temperature and generator relay interlock for actuation	1
Grouping I	Too little experience	1
Grouping J	Answer does not match the subject asked (not considered for the graphic)	7
	Total of answered questions	**35**



For this question we received many answers and the compilation of them by means of a categorized study forming categories to enable the issue of a graphic to extract a tendency among the Users was not a simple task due to the diversity of the answers. But in general it is possible to say that the variations involving automatic in conjunction with a manual alternative, or at least manual trip possibility, were the most often indicated answers. And particular situation also were mentioned as "*automatic as station are not manned*" – here it is to mention that we saw Users the have unmanned plants and leave the GFP equipment on manual resulting in a big risk for the plant.
Her we have a typical "philosophy" question, each company developed their own GFP triggering strategy. Some Users do prefer a wide flexibility, as the Chinese User, coded EMP022: "*We prefer to operate the system with fully automatic, semi-automatic and in combination with manual method*."

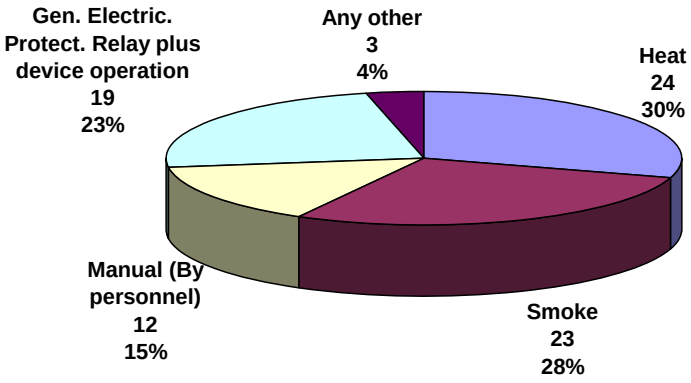
[Back to Index] [Go to Annex]

D 1.10 -

1.10) How is the fire detected in your generators? Please tick the box.
☐ - Heat
☐ - Smoke
☐ - Manual (By personnel)
☐ - Generator Electrical Protection relay operation plus one of above device operation
☐ - Any other; please specify:

This is a check box question with one alternative that calls for additional information (any other; please specify). The graphic below shows this question's results:

1.10 - How is the fire detected in your generators?



This survey has 1 Blank answer – not considered in the graph.

The usual detection systems, heat and smoke and the combination of them are more common. Althoug it is quite interesting to observe that 15% of the answers recalled for manual operation made by te operators.

[Back to Index] [Go to Annex]

Open question analysis results (any other; please specify):
The three additional explanations received can be seen on the annex. As an example we reproduce the comment sent by the German User coded: "*Smoke (detectors) not by all- there are some generators that do not have smoke detectors due to the room temperature that is too high for these sensors.*"

[Back to Index] [Go to Annex]

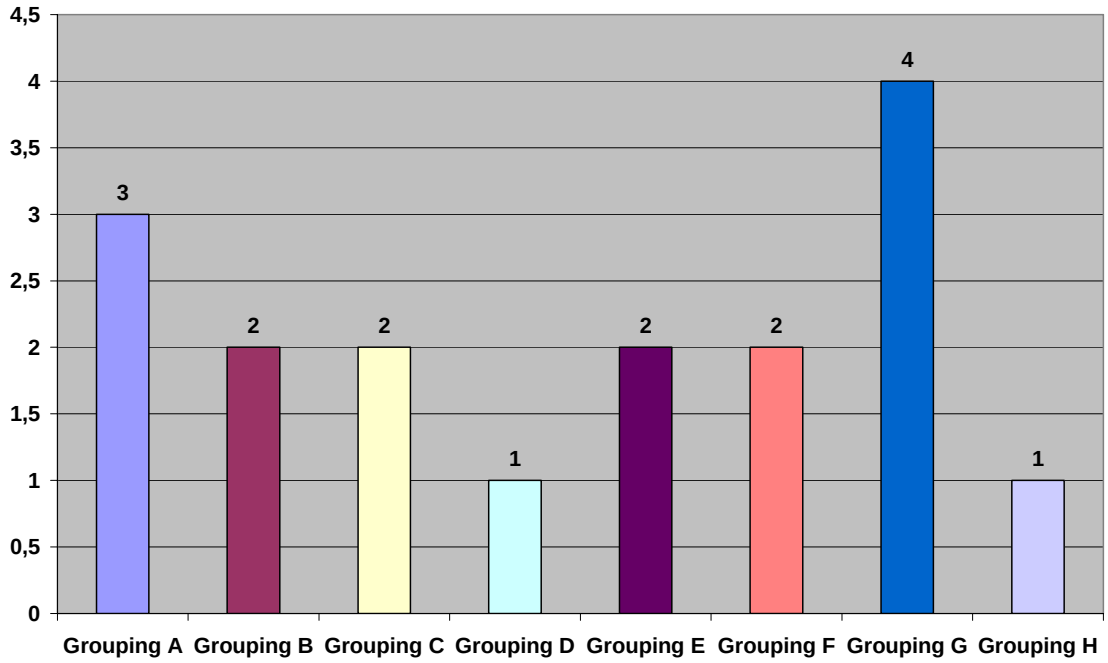
D 1.10.1 -

1.10.1) Do you have any comment about the efficiency of these detectors (heat and/or smoke)?

This is a pure open question open to all 35 Users' comments, 25 contributions were given (10 Users did not comment – 10 blanks); this allowed a categorized study of them and the results can be seen below:

1.10.1) Do you have any comment about the efficiency of these detectors (heat and/or smoke)?		
Grouping A	Standard Smoke detectors are reliable	3
Grouping B	Standard Smoke detectors are NOT reliable	2
Grouping C	Smoke detectors by aspiration (VESDA) are more reliable	2
Grouping D	Both smoke and thermal are reliable	1
Grouping E	Both smoke and thermal are NOT reliable	2
Grouping F	No comparison available	2
Grouping G	No comment	4
Grouping H	Smoke with radioactive elements require special handling care	1
Grouping I	Answer does not match the subject asked (not considered for the graphic)	8
Grouping J	Blank (not considered for the graphic)	10

Total of answered questions	35



This question showed that the opinions are splitted concerning the detectors type thus there is no clear tendency, but again the smoke detectors by aspiration (VESDA) were mentioned showing the advance of the use of this type of detectors in hydro generation. In this respect we got an interesting contribution from a User from New Zealand, coded EMP033 that reports the company philosophy in respect to detection: "*Smoke detection is seen as the most efficient as very small levels of smoke particles indicating the very early stages of a fire can be sensed by an aspirating smoke sensing system. For thermal detection to operate the temperature within the generator enclosure or windings themselves needs to reach much higher elevated levels before activating the generator fire protection system. This takes a considerable longer time compared to the activation time provided by smoke detection which may result in considerable more fire damage to the generator. 'Our company' employs an efficient automatic detection system using a voting system whereby any two of heat, smoke or generator electrical protection systems needs to be true to initiate an activation of the fire protection system. This also reduces the amount of accidental activations of the generator fire protection system*."

We also got some answers that, although expressing valid concerns, did not match the subject asked. Here two examples for the records. The Chinese User coded EMP021 stated: "*How to prevent influence from vibration or electromagnetic field to the precise measurement of these detectors is our problem.*" The Canadian User coded EMP032 expressed the following: "*Install two system: Incipient or early warning to alert the operator without deluge operation and smoke detection interlocked with '86 lock-out' electrical protection*" which is an interesting proposition for the GFP operational philosophy but does not comment about the detectors' efficiency.

The whole set of contributions can be seen on the corresponding annex.

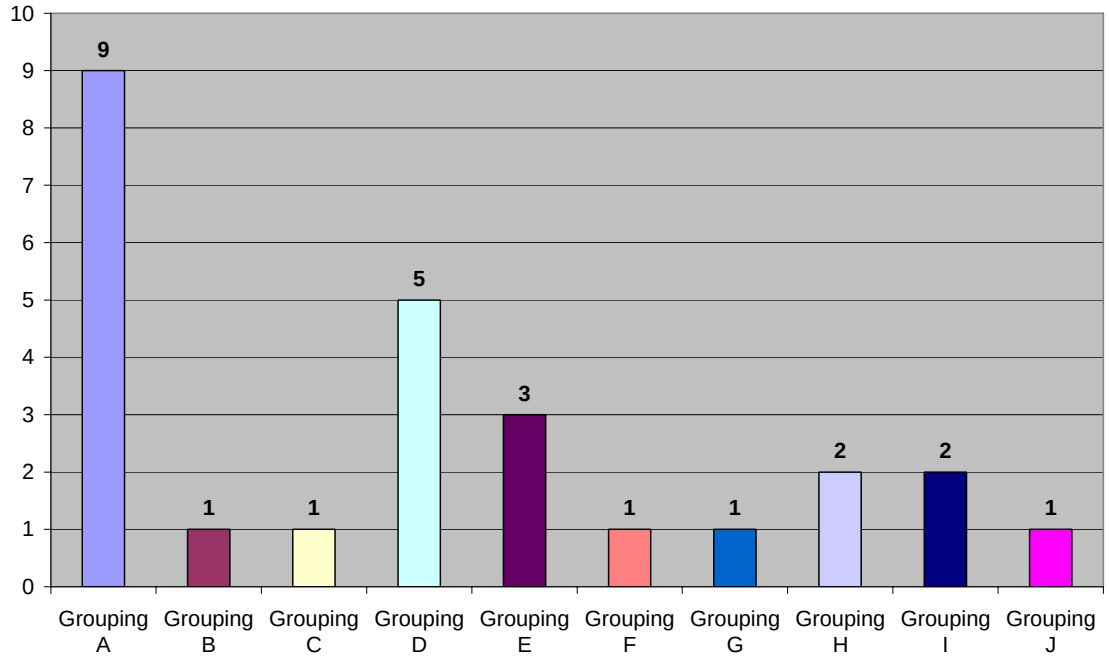
[Back to Index] [Go to Annex]

D 1.11 -

1.11) How do you prevent unwanted (unnecessary-accidental) release of generator fire extinguishing system? (Eg- dual detection method) Please specify here:

For the sake of completion we recall the categorized study already presented in the first part of this work.

Grouping	Legend	Quantity
Grouping A	Dual protection	9
Grouping B	No protection for unwanted trip	1
Grouping C	VESDA detection system	1
Grouping D	Include generator electrical protection (eg. Differential Relay)	5
Grouping E	Block CO2 at inspection works	3
Grouping F	Mechanical stoppers	1
Grouping G	Manual activation	1
Grouping H	Voting system involving two out of smoke or heat detectors, or electrical protection	2
Grouping I	Check fire alarms in intervals	2
Grouping J	Trip occurs if any of the available detectors (heat or smoke) or electrical protection actuates	1
Grouping K	Did not answer (not considered for the graphic)	9



The received answers show that the use of dual protection, including the generator's electrical protection and blocking of CO_2 during maintenance show up as most commonly used methods to prevent unwanted GFP release. As an example of the comments given in favor of the dual protection (Grouping A) we reproduce what an Austrian User coded EMP054 reported: "*We have 3 circuits of heat and smoke detector in the generator ring area (inside the generator housing). If 2 circuits are activated the extinguishing system starts. If the door of the generator ring (housing) area is open the CO2 extinguishing system is blocked*." The inclusion of the generator electrical protection (Grouping D) was commented by the Brazilian User coded EMP045 in the following way: "*We try to prevent unwanted release of the system using the information of the sensors integrated with the electric protection of the generator."*
About the blocking of CO_2 during maintenance (Grouping E) the Swedish company coded EMP019 sent the following comment: "*The CO_2 system is blocked when there is work going on inside the generator i.e. inspection*."

For all the given comments pleas relay to the corresponding annex.

[Back to Index] [Go to Annex]

D 1.11.1 -

1.11.1) At your present installation did you have unwanted (unnecessary-accidental)

release of generator fire extinguishing system with consequent release of extinguishing media?
☐ - Yes ☐ - No
If yes, please specify:
Number of unwanted (unnecessary-accidental) releases of fire protection per unit per year:

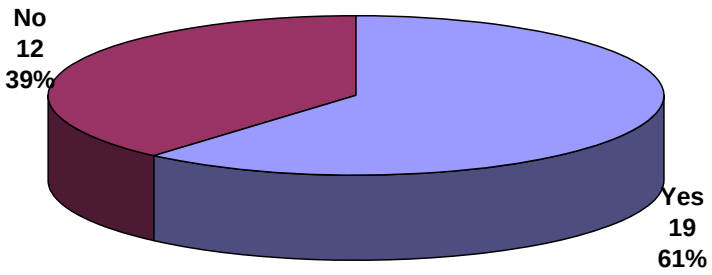
Outage duration that resulted due to clean up:

If you know the reason of these incidents, please specify?

This question had a complex structure that started with a check-box question that was complemented with 3 open questions calling for specific additional information.

Starting with the result of the check-box question:

1.11.1 - At your present installation did you have unwanted (unnecessary-accidental) release of generator fire extinguishing system with consequent release of extinguishing media?



This survey has 4 Blank answers – not considered in the graph.

[Back to Index] [Go to Annex]

Open question analysis results this question was complemented by three additional exploratory questions that are shown in the table below with the corresponding answers. Due to the diversity of answers the best way to present the contributions is in form of a table.

Users	Number of unwanted (unnecessary-accidental) releases of fire protection per unit per year:	Outage duration that resulted due to clean up:	If you know the reason of these incidents, please specify?
EMP005-SUI	blank	blank	blank
EMP013-BRA	blank	blank	blank
EMP051-AUT	blank	blank	blank
EMP009-JPN	blank	blank	blank
EMP028-JPN	blank	blank	blank
EMP037-RUS	blank	blank	blank
EMP010-CAN	blank	blank	blank
EMP012-MEX	blank	blank	blank
EMP016-BRA	blank	blank	blank
EMP019-SWE	blank	blank	blank

EMP020-BRA	blank	8 hours	blank
EMP021-CHN	blank	blank	blank
EMP027-MKD	blank	6 hours	electrical damage outside the generator
EMP026-SWE	blank	blank	blank
EMP053-POL	blank	blank	blank
EMP038-SWE	blank	blank	blank
EMP040-NOR	blank	blank	blank
EMP031-MEX	blank	blank	blank
EMP023-ESP	0,004	blank	Un-adverted tripping of master relays during protection relays testing.
EMP025-BRA	0,004 (2 releases in 20 units in 24 years)	2h 04min	The first unwanted release occurred due to a short-circuit in the GFP board. In the second case, an improper discharge of CO2 and trip occurred due to the incorrect operation of thermal and smoke detectors.
EMP045-BRA	0,03 releases / year for each generator	4 hours	They are: sensor defect, human accidental operation, problems with de CO2 system components.
EMP054-AUT	0,05	0,5 days	faulty activation of protection system
EMP008-BRA	1	blank	accidental
EMP049-SWE	1 release in 20 years	1 day	testing of relay protection, fault in CO2 relay system or detection system
EMP056-SUI	2 in 20 year	0,5 days	faulty manual operation
EMP036-CAN	5 in the last 20 years	7 days or more	blank
EMP032-CAN	>6	7 to 90 days	Welder working in the vicinity of a unit (created smoke) and generator happened to trip on electrical fault, thus triggering the water deluge
EMP006-SUI	approx. 15 since 1981	6 hours	blank
EMP039-AUS	In the past we had one per year CO2 releases- particularly where smoke was one of the inputs and release is managed by a central fire board. We have removed all CO2 installations and now in the process of installing water based protection on selected unit	4 hours	oil casing smoke
EMP048-GER	Multiple releases because of unwanted activation of electrical protection.	blank	blank
EMP043-JPN	One or less	blank	blank
EMP015-NZL	The CO2 system was prone to accidental releases, usually human error, made worse by the fact that it was not a dual activation system.	1 hour	human error
EMP058-BRA	The number per year of unwanted releases of fire protection is about 0.5/year.	3 days	Personal failure operation and same occurrence of false protection operation during commissioning
EMP033-NZL	Typically, one accidental release every 7 years across 39 generator units = 0.004 accidental release per unit per year.	10 hours	Varies, typically false activation of smoke and/or thermal detection system.
EMP055-USA	Unknown	1 to 3 days	false signal

One unwanted outage reason that often occurs is human error and this factor is present in the table above; as it is the case of the User from Nez Zealand, coded EMP015-NZL, that reported (we repeat): "*The CO2 system was prone to accidental releases, usually human error, made worse by the fact that it was not a dual activation system."*

There are being made removal of CO_2 systems and substitution by water as it is the case reported by the Australian User, coded EMP039-AUS, (we repeat): "*In the past we had one per year CO_2 releases- particularly where smoke was one of the inputs and release is managed by a central fire board. We have removed all CO_2 installations and now in the process of installing water based protection on selected unit.*" Here we recall

the increasing environmental concerns in many countries regarding contaminated wait water after a fire combat. In one power plant not originally planned for the use of water as extinguishing media the required environmental safe exhaust of water may be either impossible or represent large adaptation works. As the other tendency shows the substitution of CO_2 by inert gas (Inergen for instance) brings a clean and safe solution. Little overhaul works and an residue (or moisture) free extinguishing.
As a matter of fact the good engineering practice tells that the fire extinguishing system is not a matter of a choice and installation after the plant is ready. Nowadays the basic concept or a hydraulic power plant has to consider the particular extinguishing media already at the basic design stage; due to the involved structural provisions that the chosen GFP system may require.

[Back to Index] [Go to Annex]

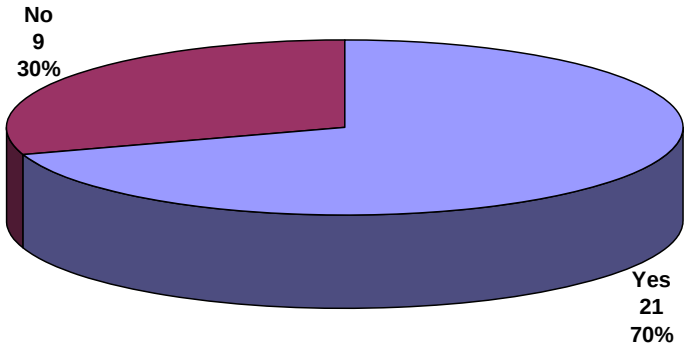
D 1.12 -

1.12) In an event of fire is detected by the devices installed (eg. Smoke, heat etc), will extinguishing media release immediately without any delay or any manual interference? ☐ - Yes ☐ - No If No, please inform the steps of releasing the extinguishing media:

This check-box question is a control question considering former questions. The negative question is explored by an open question.

The check-box question shows the following results:

1.12 - In an event of fire is detected by the devices installed (eg. Smoke, heat etc), will extinguishing media release immediately without any delay or any manual interference?



This survey has 5 Blank answers – not considered in the graph.

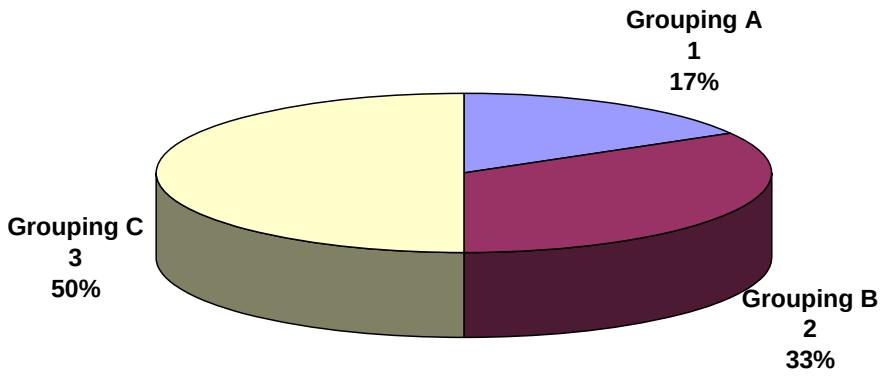
In this case the 60% (21 Users) of the participant Users do not consider the necessity of having a delay between the detection and the release of the extinguishing media; and those 26% (9 Users) that answered no had the following to say:

[Back to Index] [Go to Annex]

Open question analysis results (if No, please inform the steps of releasing the extinguishing media):

1.12) In an event of fire is detected by the devices installed (eg. Smoke, heat etc), will extinguishing media release immediately without any delay or any manual interference? If No, please inform the steps of releasing the extinguishing media:		
Grouping A	Alarm (acoustic and optical) comes prior to release	1
Grouping B	Manual release	2
Grouping C	Time delay for release	3
Grouping D	Answer does not match the subject asked (not considered for the graphic)	3
	Total of answered questions	**9**

1.12) In an event of fire is detected by the devices installed (eg. Smoke, heat etc), will extinguishing media release immediately without any delay or any manual interference?



The result of the categorized study of the additional explanations given in the case of a delayed release of the extinguishing media shows that in most cases either the delay is caused by a pre-selected times, as for instance the User from New Zealand coded EMP033 reported: "*wait 30 seconds before discharging extinguishing media*"; or by means of manual trip, that inputs an arbitrary delay to the action of releasing the GFP, as informed by the Macedonian User, coded EMP027: "*operator will activated the fire protection.*"

[Back to Index] [Go to Annex]

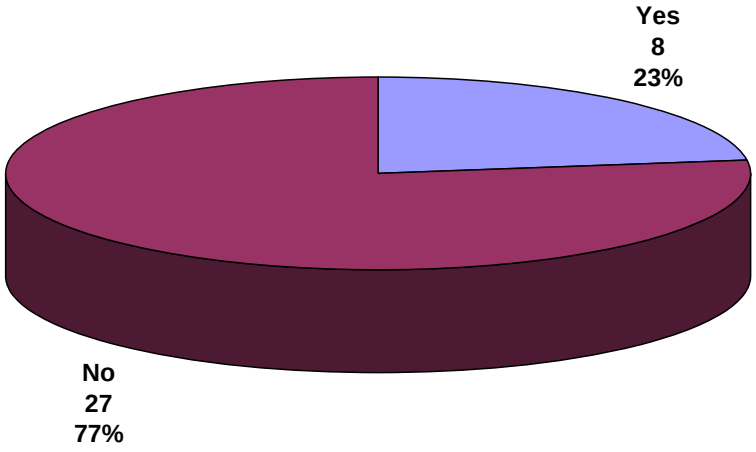
D 1.13 - **Do you consider bearings as a potential fire hazard for generators?**

1.13) Do you consider bearings as a potential fire hazard for generators?
☐ - Yes ☐ - No

The questions 1.13 and 1.13.1 deal with a controversial question regarding the bearings as being a fire hazard to be considered in the design and execution of GFP systems. Both items were stated as check-box questions.

The present pure open question 1.13 gave the following result:

1.13) Do you consider bearings as a potential fire hazard for generators?



The “tradition” was confirmed herewith with the NO having received 77% (27 Users) votes. On the other had it is not to neglect the possibility of oil vapour get in to the machine in some constructive types. Although nowadays the initial oil charge uses to be of a special flame retardant oil type it happens sometimes that when the oil is replaced standard type of oil is used increasing the risk to the unit. The occurrence of oil vapour leakage is a kind of “*Achilles' heel*” for many generator constructors… All this aspects shall be taken in to consideration when a risk assessment study for a particular power plant is made; and it is not to forget that not only the pristine conditions of new generators shall be considered but the real situation after some years of use should not be forgotten.

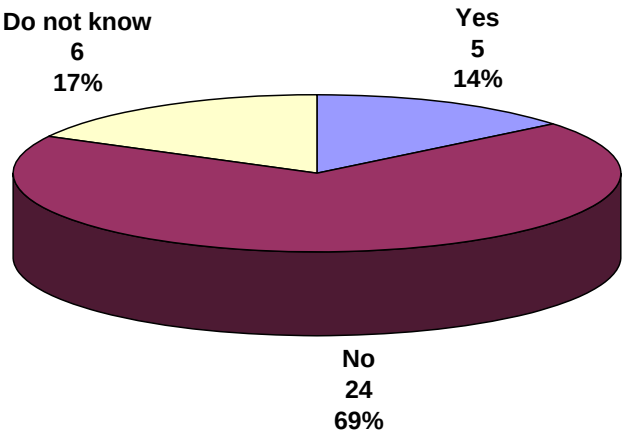
[Back to Index] [Go to Annex]

D 1.13.1 -

1.13.1) Are your generator fire protection systems designed to fight bearing fires? ☐ - Yes ☐ - No ☐ - Do not know

This is a control question that intends to survey the real bearings protection scheme installed.

1.13.1 - Are your generator fire protection systems designed to fight bearing fires?



This is an important result that shows that there are units with fire protection also for their bearings, although it is a quite rare; in this case we had a positive confirmation of at least 14% (5 Users) of the participating companies of a total of 35.

[Back to Index] [Go to Annex]

D 1.14 -

1.14) Do you specify provisions to remove fire extinguishing media?
☐ - Yes ☐ - No
If yes, for water –spray: does it include provisions for decontamination in case of water used for extinguishing a fire?
Please specify here:

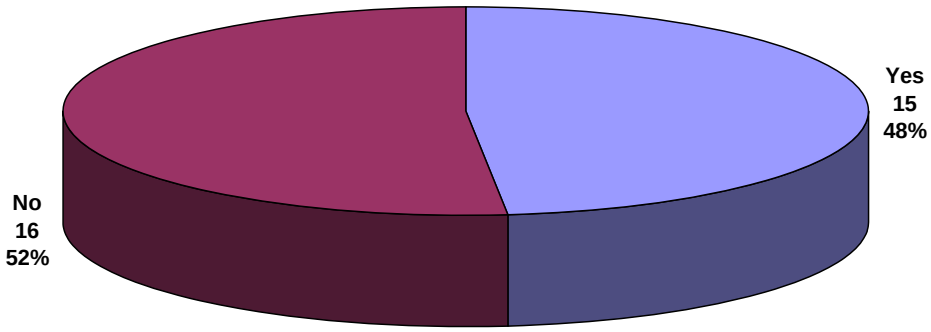
If yes, for CO2: do you have an exhaust system that removes the media out of the room?
Please specify here:

This question aims to verify the actual quality of the installed GFP design considering its integration in the power plant's design. Normally the provisions for the proper installation, considering the storage (and or supply) of the extinguishing media, the required piping outside the generator pit, as well as the normally required provisions for the removal of the extinguishing media shall be part of the plant's basic design, it means from the very begin of the project. The point addressed by this question is the provisions to remove the fire extinguishing media. Which is quite important moreover if the media used is CO_2.due to the fact that CO_2, that is transparent and normally has no smell (in many cases a fragrance is added to make it possible to smell leakages), has a density greater that air and may accumulate in low levels thus causing hazard to staff personnel passing nearby the accident area. If the media used is water there are environmental concerns with the required segregation and treatment of the extinction waste water, as already commented before.

The question was divided in three parts, one check-box question and two exploratory questions dedicated to CO_2 and to water respectively.

The check box result is the following:

1.14) Do you specify provisions to remove fire extinguishing media?



This survey has 4 Blank answers – not considered in the graph.

[Back to Index] [Go to Annex]

Here we can see that almost the half of the participant Users do not have provisions to exhaust the used fire fighting media. But in order to go a step deeper in this survey let's see the answers for the following open questions:

Open question (1) analysis results (if yes, for water spray: does it include provisions for decontamination in case of water used for extinguishing a fire?**):**

The 6 received answers were categorized with the result below:

Do you specify provisions to remove fire extinguishing media? If yes, for water–spray: does it include provisions for decontamination in case of water used for extinguishing a fire? Please specify here:		
Grouping A	Drainage of water to decontamination - oil water separator	2
Grouping B	No decontamination foreseen	4
	Total of answered questions	**6**

As it can be seen from the table above two companies indicated to have provisions to remove and decontaminate the waist water, this is a quite low figure. This is reported in this way by the Canadian User coded as EMP010: "*The water spray drains into a drainage sump and is filtered through an oil-water separator. Then only the water is pumped out into the surge chamber which runs out into the tailrace tunnel*."
It is to expect that the next environmental project permissions will call for this type of precaution as a must to be installed.

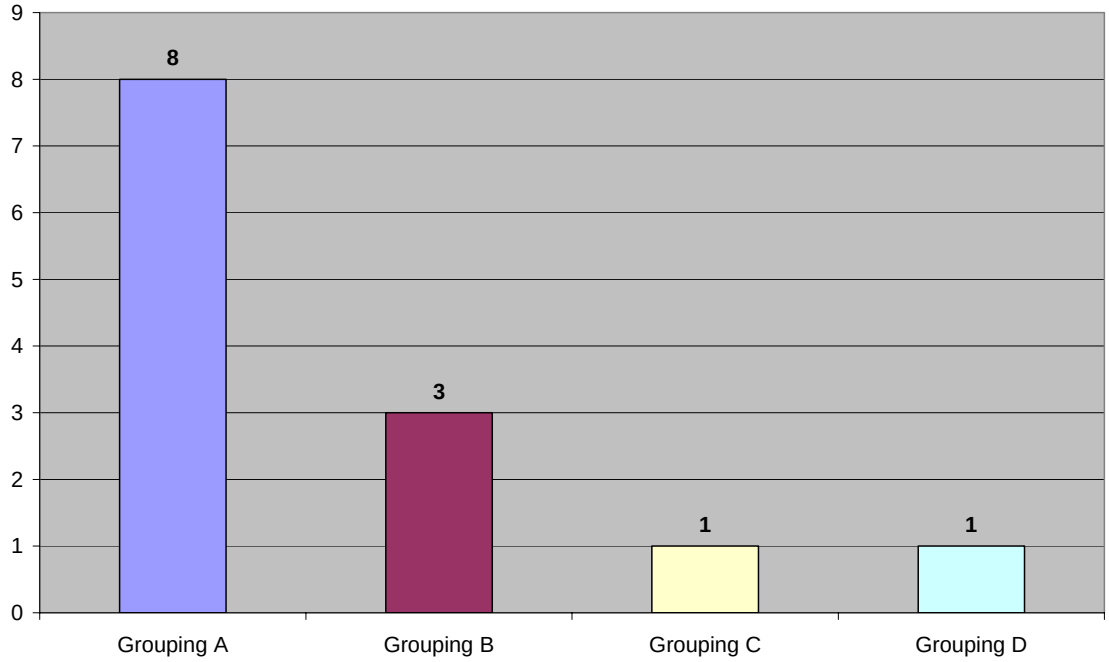
[Back to Index] [Go to Annex]

Open question (2) analysis results (If yes, for CO2: do you have an exhaust system that removes the media out of the room?)**:**

Here the table of the categorized answers shows the following result:

Do you specify provisions to remove fire extinguishing media? If yes, for CO_2: do you have an exhaust system that removes the media out of the room? Please specify here:		
Grouping A	Fix exhaust system	8
Grouping B	Portable exhaust system	3

Grouping C	Separate exhaust channels	1
Grouping D	No separate exhaust system available	1
	Total of answered questions	**13**



As expected, considering the security of personnel the extraction of CO_2 receives more attention from the Users involved. The most installed alternative is the fix exhaust system. The User from Brazil, coded EMP016, explains the measures that are being implemented concerning this safety issue: "*The CO_2 exhaustion systems that we have are composed by exhausters and pipes that lead the internal generator air to the outside of the power house. The system is operated manually when a CO_2 discharge occurs, to allow the removal of the same from the interior of the generator housing.*"
Next we have the use of portable exhaust systems as the American User, coded EMP055, explains: "(we) do not have a dedicated system, but use a portable venting system" by this means the removal of the remaining CO_2 is possible.

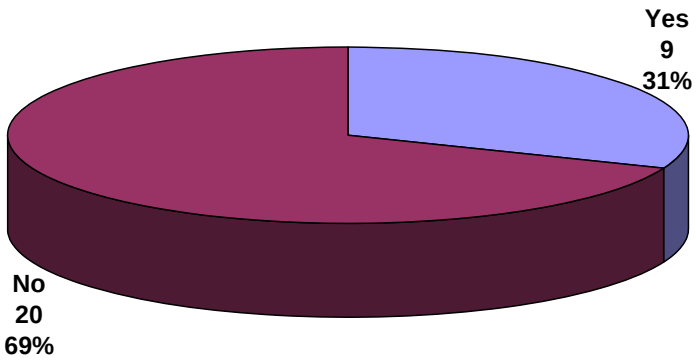
[Back to Index] [Go to Annex]

D 1.15 -

1.15) Do you specify automatic open/close relief vents on the generator housing to relieve excessive inrush extinguishing media pressure while maintaining extinguishing media concentration within the generator housing for the specified extinguishing time?
☐ - Yes ☐ - No

The proper design of a GFP has to take in to consideration the action of the extinguishing media and has to provide conditions for this action to occur properly. In the case of CO_2, for instance, a certain concentration of CO_2 in the generator has to be kept during a time specified by the corresponding Standards (NFPA for instance). The normal practice is to have two CO_2 release circuits in the case of total flooding, one for inrush with high pressure, for the first combat; and a second for long time application to keep the required concentration. In this case the generator housing has to keep tight also during the inrush of the first application and no door or other housing closing ought to be destroyed by the inrush overpressure, because this would jeopardize the extinguishing procedure by not allowing the proper concentration of CO_2 to be maintained during the given time. In order to prevent this to happen in some cases some calibrated pressure relief vents are installed. This check-box question is looking for the conditions of the installed units and gave the following result:

1.15) Do you specify automatic open/close relief vents on the generator housing to relieve excessive inrush extinguishing media pressure?



This survey has 6 Blank answers – not considered in the graph.

In this case we have 09 Users that do have the described inrush pressure relief vents.

[Back to Index] [Go to Annex]

D 1.16 -

1.16) What is the maximum number of machines protected by one storage? Please specify the extinguishing media:

This question and the following deal with extinguishing media storage characteristics.

This open type question's 1.16 in fact is divides in two parts, as follows:
-Indication of the maximum number of machines protected by one storage,
-Specification of the corresponding extinguishing media

The answers of these two parts were collected in a table as follows:

1.16		Please specify the extinguishing media				
COMPANY	Number per Storage	CO_2	H_2O	N_2	Chem. Powder	Blank
EMP005-SUI	-					1
EMP013-BRA	-					1
EMP051-AUT	-					1
EMP009-JPN	-					1
EMP028-JPN	-					1
EMP037-RUS	-					1
EMP006-SUI	-					1
EMP026-SWE	-					1
EMP019-SWE	1	1				
EMP023-ESP	1	1				
EMP040-NOR	1	1				
EMP056-SUI	1	1	1	1		
EMP010-CAN	11		1			
EMP032-CAN	12		1			
EMP016-BRA	2	1				
EMP025-BRA	2	1				

EMP053-POL	2	1				
EMP045-BRA	2	1				
EMP047-SWE	2	1				
EMP048-GER	2			1		
EMP038-SWE	3	1				
EMP008-BRA	3	1				
EMP054-AUT	4	1				
EMP031-MEX	6	1				
EMP033-NZL	7	1				
EMP015-NZL	8		1			
EMP036-CAN	no limit		1			
EMP027-MKD	4	1				
EMP055-USA	4	1				
EMP058-BRA	4	1				
EMP021-CHN	no limit		1			
EMP039-AUS	no limit		1			
EMP043-JPN	1				1	
EMP020-BRA	1	1				
EMP012-MEX	1	1				
	Total	19	7	2	1	

For water there is no limit of machines per storage as the Australian User, coded EMP039 commented: "*No maximum size of supply to meet demand for one unit and manual fire fighting. Redundancy to meet fire NFPA and Australian Fire Codes.*" For CO_2 the concepts may vary. We reproduce here the comment of the User from New Zealand, coded EMP033: "*7 units, served by an in-service bank of CO_2 cylinders with a spare reserve bank of CO_2 cylinders. The reserve bank is fully connected but requires manual switchover.*"

[Back to Index] [Go to Annex]

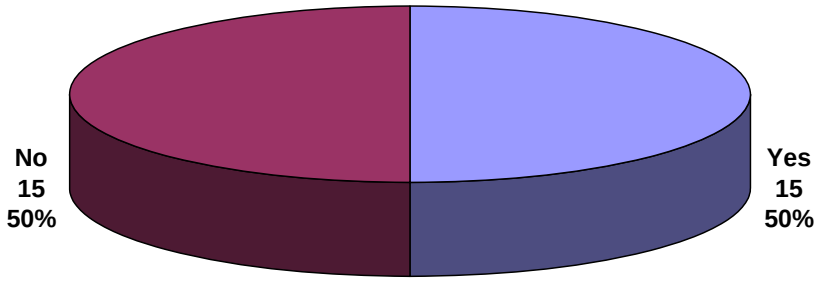
D - 1.16.1 -

1.16.1) Do you have main and reserve storage for each group of protected machines?
☐ - Yes ☐ - No
If yes, please specify here:

This question was divided in two parts, one as a check-box question and the other as a complement open question for the positive answers.

Staring with the check-box question we have:

1.16.1) Do you have main and reserve storage for each group of protected machines?



This survey has 5 Blank answers – not considered in the graph.

[Back to Index] [Go to Annex]

Open question analysis results (if yes, please specify here):
The open question for the positive answers of the check-box question resulted in four answers, 03 dealing with CO_2 and one for water. In the case of CO2 there are answers for "dynamic" back up storage with main and reserve cylinder banks connected to the machine housing by an automatic or manual switchover valves (this allows an additional security degree by means of a "ready to go" back-up storage), as the additional information given by the Brazilian User coded EMP058: "*Normally is used two groups, one reserve of the other."* Still about CO2 a peculiar answer was given by the American used coded EMP055 that said: "*Normally the reserve storage is extra bottles in the warehouse*." In this case no real back-up storage is granted.
For water as media the following comment was given by the Canadian User, coded EMP010, which uses: "*water storage basins.*"

[Back to Index] [Go to Annex]

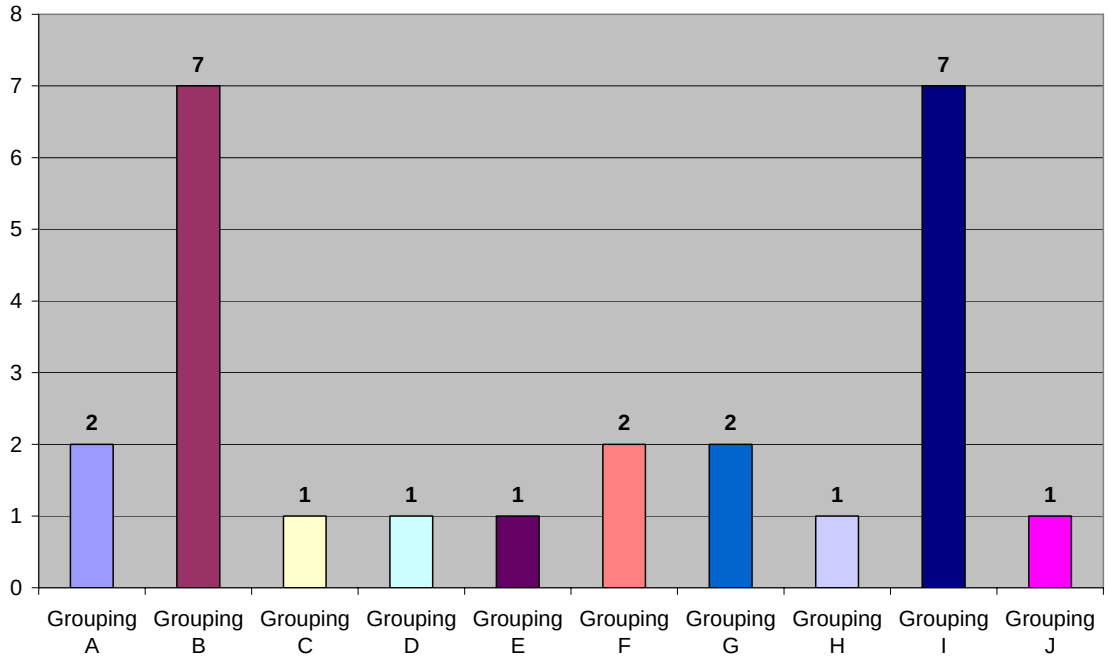
D 1.17 -

1.17) What is the future trend for extinguishing media?

For this open type question we got 26 contributions that were categorized with the following result:

1.17) What is the future trend for extinguishing media?		
Grouping A	CO2 - remains	2
Grouping B	Water - remains	7
Grouping C	Fire extinguisher (dry chemical powder) -remains	1
Grouping D	Foam extinguisher	1
Grouping E	New media like chemical dust, CO2 and halogen composites	1
Grouping F	Inert gas (INERGEN and alike)	2
Grouping G	Inert gas (INERGEN and alike) and water	2
Grouping H	Inert gas, water or none	1
Grouping I	NO fire protection at all	7
Grouping J	NO evolution foreseen	1
Grouping K	Answer does not match the subject asked (not considered for the graphic)	1

Total of answered questions	26



Two groups of answers present the tendency in this case. The Grouping B calls for maintenance of water as extinguishing media. The Chinese User coded EMP021 recalls water but is open for new medias as stated in his comment: "*At the moment, we still apply water as a appreciate media. An update media available for environment and no harmful for health is under research and study*."
The Grouping I calls for no GFP at all, as the Spanish User coded EMP023 reports: "*As it has been mentioned, fire protection systems have been removed according to the generator rewinding program depending on the age of the stator and according to the conditions of the insulation. At the same time of the rewinding process, insulations are renewed using new fireproof materials.*" Here we recall about the still open questions about the alleged fireproof condition of the epoxy based insulations since there are reports of accidents although the unit had this type of insulation, as already stated before.
We call your attention to the statement to the inert gas alternative and water from the Groping G given by an User from New Zealand, coded EMP033: "*Our company's intention is to maintain CO_2 generator fire protection systems on Meridian's above ground power stations. For underground power stations Meridian's intention will be to provide a clean agent gas suppression systems such as Inergen or Argonite. In terms of international trends, we see that CO_2 will be phased out due to its harmful affects to personnel, more gas suppression systems will employ gases such as Inergen and Argonite, and more water mist systems will be employed as generator insulation systems become more tolerant to moisture absorption.*" A comment here regarding the statement about water mist is that the moisture problem is usually not related to the insulation like such, because it is not difficult to get it dry and the epoxy based insulations are known as water resistant, the major question are the stator core and other components that may be affected by moisture mainly in hard accessible locations.

The other comments can be seen on the corresponding annex.

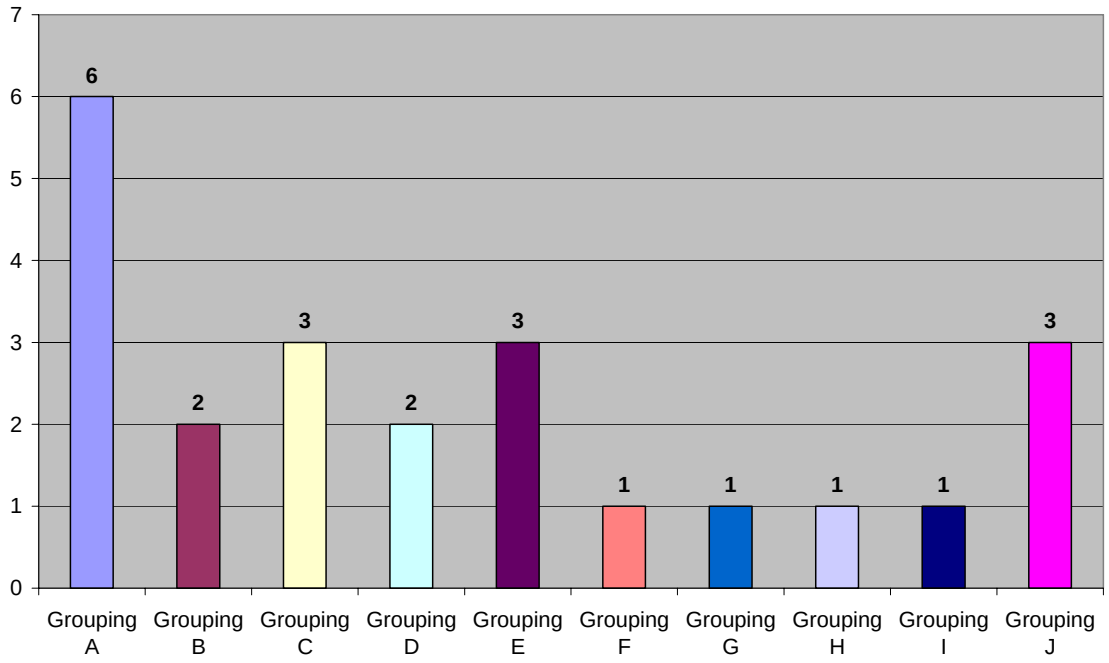
[Back to Index] [Go to Annex]

D 1.18 - **What is the future trend for fire detection?**

1.18) What is the future trend for fire detection?

This is a pure open question stated as a brainstorming to gather ideas about future perspectives on the fire detection field, in this case we got 25 contributions that were categorized and the obtained result is the following:

1.18) What is the future trend for fire detection?		
Grouping A	Heat and smoke detectors - remain	6
Grouping B	Advanced smoke detectors (VESDA)	2
Grouping C	Smoke detectors -remain	3
Grouping D	NO perspective of sensor's evolution	2
Grouping E	Combination of detectors and relays monitored by an automatic system (e.g.. artificial intelligence)	3
Grouping F	Chemical analysis of cooling air	1
Grouping G	HAD and split phase	1
Grouping H	Incipient and early detection in combination of heat and smoke	1
Grouping I	Electric arc detection	1
Grouping J	NO detection and NO GFP	3
Grouping K	Answer does not match the subject asked (not considered for the graphic)	2
	Total of answered questions	**25**



The grouping A that call for the maintenance of smoke and heat detectors got 6 votes that seems to show a tendency of continuity. As recalled by the Japanese User coded EMP028, that said: "*Same as ever (Smoke and heat).*" There is a group supporting the maintenance of smoke detectors with 3 votes – Grouping C; as the Swedish User coded EMP019 said: "*More smoke detection as a relay protection.*" Also with 3 votes the Grouping E recalls for relays connected via artificial intelligence; this alternative is supported by the Brazilian User coded EMP045 that said: "*It looks that will be the integration of several signs of sensors and electric protections monitored by artificial intelligence (Fuzzy, neural nets).*" This is a real innovative idea. The group that foresees no detection at all and no GFP was evaluated by the Grouping J and also got 3 votes. About this alternative the Spanish User coded EMP023 wrote: "*The trend is the next one: - In new machines there will not be installed any fire extinguishing system. New machines are specified with fireproof materials. Fire detection systems and remote alarm will be installed. -In case of machines with no-fireproof materials, the fire extinguishing systems will be reviewed and will be kept in operation. -In case of machines refurbished with fireproof materials, the already installed fire extinguished systems will be kept, reviewed and maintained in operation.*"

All original comments can be seen on the corresponding annexes.

[Back to Index] [Go to Annex]

D 1.19 -

1.19) In case of fire, smoke constitutes a major problem on visibility, orientation, breathing capacity, etc. Therefore it is desirable to provide adequate means of combating while involving minimum risk to personnel. In this line please check which additional provisions you do foresee in your plants:
☐ - routine personnel fire fighting and fire escape training
☐ - clearly indicated (illuminated large numbers located low) escape routes
☐ - breathing apparatus (with pertinent use training) or air line system
☐ - emergency lightning located low and personnel own miner type hand lamps
☐ - areas subject to CO_2 clearly indicated, with door interlocks, acoustic and visual alarms
☐ - use of odorized CO_2 only with routine crew recognition training on the fragrance used
☐ - plant ventilation system tested not to recirculate smoke in to the housing in case of fire
☐ - routine check of the generator housing and proper maintenance of openings, doors, etc.
☐ - others, please specify:
☐ - all of the above
☐ - none of the above
Comments on this issue:

The questions 1.19 and 1.19.1 deal with staff safety and emergency plans.

This item was meant to collect the precautions Users undertake to offer more safety to the involved plant operation personnel. Due to the length of this survey these items were dealt in the form of check-box questions with two correlated open questions. One to explain the alternative “others” and other to comment this issue.

Starting the 1.19 question with the check-box question that will be presented item per item:

Which of these provisions you foresee in your plant:	Votes
Routine personnel fire fighting and fire escape training	28
Clearly indicated (illuminated large numbers located low) escape routes	28
Breathing apparatus (with pertinent use training) or air line system	23
Emergency lightning located low and personnel own miner type hand lamps	24
Areas subject to CO_2 clearly indicated, with door interlocks, acoustic and visual alarms	22
Use of odorized CO_2 only with routine crew recognition training on the fragrance used	09
Plant ventilation system tested not to recirculate smoke in to the housing in case of fire	20
Routine check of the generator housing and proper maintenance of openings, doors, etc	24
Others, please specify: [please see below]	06
All of the above	07
None of the above	02

As these statistics show almost all of the provisions are being undertaken by a significative number of Users, thus keeping a high degree of safety.

[Back to Index] [Go to Annex]

Open question (1) analysis results (others, please specify):
Let's address the "others" alternatives that received the following contributions:
-The User from New Zealand coded EMP033 called for: "*enhanced maintenance and testing to ensure the condition of generator fire protection components and system is maintained and the control and activation system operates correctly*."
-The Canadian User coded EMP032 called for: "*Manual fire fighting capabilities such as hose-cabinets and hose reel stations."* Here we would like to point out that in many countries, like Brazil for instance, the generator housing external fire fighting equipment, as hydrants and hose reel stations are defined by the construction code and the Fire Fighting Department in charge.

[Back to Index] [Go to Annex]

Open question (2) analysis results (comments on this issue):
To conclude this question we present the results of the open question that asked for comments on this issue. As this is a security issue we present the received comments as follows:
-From the New Zealand User coded EMP015: "*Believe that the warning systems and training that are already in place cover the requirements. Generator fires are generally self extinguishing, and the company policy is that fire fighting is left to the professionals. There are regular trial evacuations and alarms and lighting are checked regularly. If staff is working in dangerous spaces where O2 levels could fall below life sustaining levels they are required to take an escape breathing kit with them.*"
-From the Mexican User coded EMP012: "*Implement the design of the underground power plants in order to make the smoke extraction on the top of the plant's ceiling. The present extraction nozzles are at the level of the boards.*"
-From the Mexican User coded EMP031: "*Implement monitoring systems and efficient fires smothering."*
-From the Canadian User coded EMP036: "*In the past, when CO2 was in use, the signs indicated a warning. The indication here is just to share what was used when CO2 was used*."
-From the New Zealand User coded EMP033: "*Maintenance & testing of older CO2 generator fire protection systems is often overlooked and carried out poorly. Consequently operators, maintainers and technical staff have little confidence that the CO2 systems would work properly when required."*
-From the Chinese User coded EMP021: "*Special provisions are taken into account as indicated above, the risk to personnel will be reduced to a minimum. Any way, great attention should be paid*."

[Back to Index] [Go to Annex]

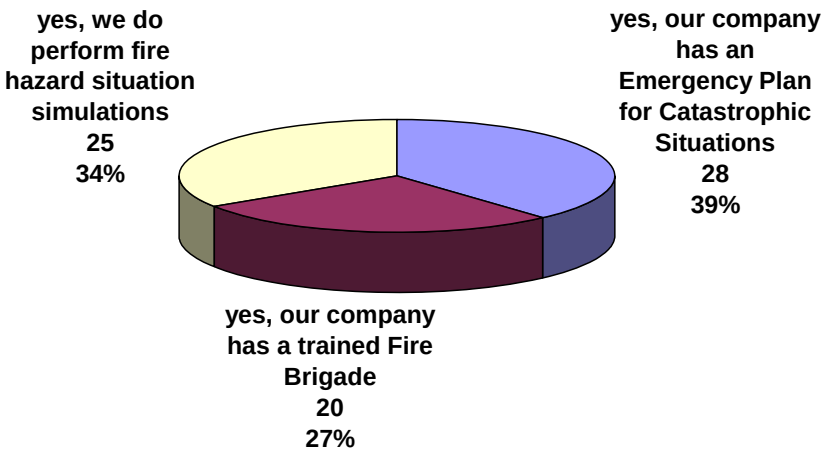
D 1.19.1 -

1.19.1) Additionally to these items the existence on an Emergency Plan, a Fire Brigade and Simulations are very actual, being so please answer the following items:
☐ - yes, our company has an Emergency Plan for Catastrophic Situations
☐ - yes, our company has a trained Fire Brigade
☐ - yes, we do perform fire hazard situation simulations times a year.
Comments on this issue:

This is a check-box question with two additional extension questions in form of open questions, one asking for the number of hazard simulations performed in a year; and the other is a general request for comments.

Starting with the check-box question we have:

1.19.1) Additionally to these items the existence on an Emergency Plan, a Fire Brigade and Simulations are very actual...



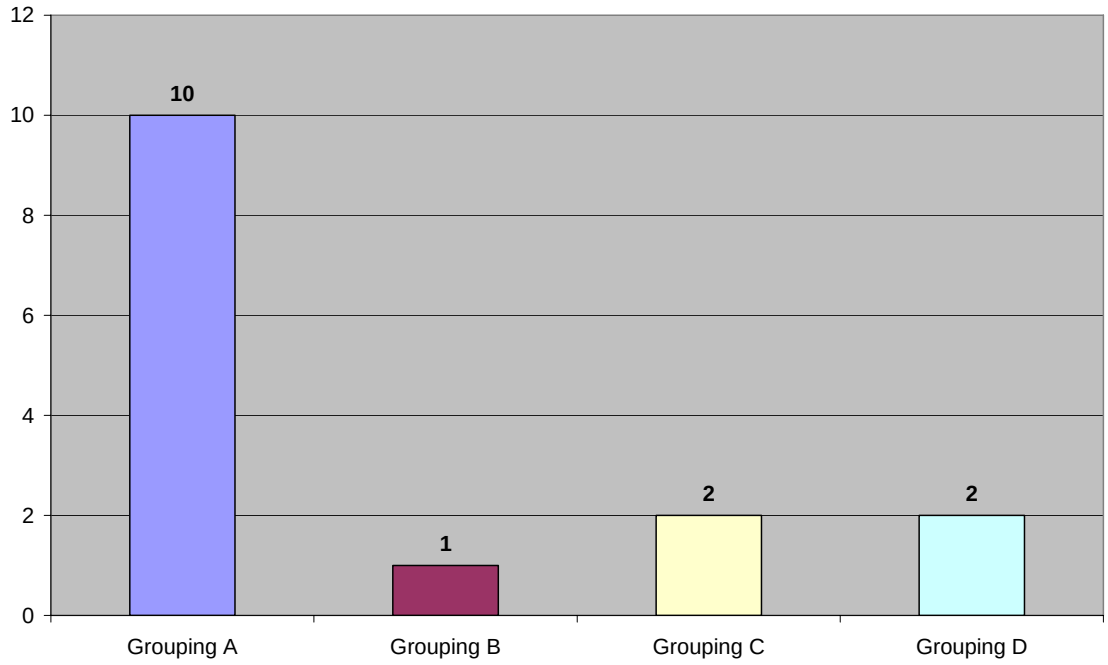
This survey has 1 Blank answer – not considered in the graph.

The results show a high degree of prevention policies undertaken by the Users,

[Back to Index] [Go to Annex]

Open question (1) analysis results (yes, we do perform fire hazard situation simulations NN times a year):
The open question regarding the number of hazard simulations made per year received 15 contributions and resulted as follows:

1.19.1) Additionally to these items the existence on an Emergency Plan, a Fire Brigade and Simulations are very actual: yes, we do perform fire hazard situation simulations NN times a year		
Grouping A	One (1) simulation a year	10
Grouping B	Two (2) simulation a year	1
Grouping C	Three (3) simulation a year	2
Grouping D	Unknown	2
	Total of answered questions	**15**

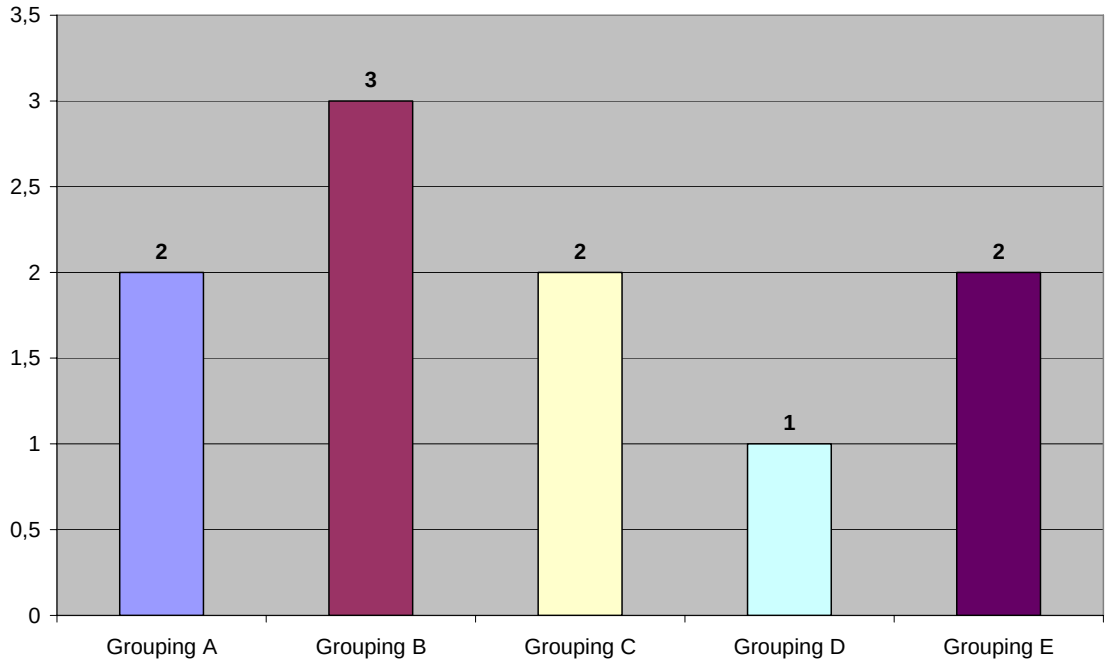


Ten of the 15 Users that answered to this question do perform fire hazard simulations once a year.

[Back to Index] [Go to Annex]

Open question (2) analysis results (comments on this issue):
To conclude the item 1.19.1 the open question asking for comments on this issue, here the results of a categorized study:

1.19.1) Additionally to these items the existence on an Emergency Plan, a Fire Brigade and Simulations are very actual: Comment on this issue		
Grouping A	Focus on internal trainings with staff and fire internal brigade	2
Grouping B	Focus on trainings and collaboration with public Firemen	3
Grouping C	Focus on training on emergency conditions, not only fire	2
Grouping D	Responsibility transferred to official Firemen (state owned)	1
Grouping E	Other aspects.	2
	Total of answered questions	**10**



Some additional information given by the Users involved:
-An example of comment for the Grouping A [Focus on internal trainings with staff and fire internal brigade] given by the Brazilian User coded as EMP045: "*There are trained Fire Brigade to this cases and also internal commissions, to prevent accidents in general (including fire)*."
-An example of comment for the Grouping B [Focus on trainings and collaboration with public Firemen] given by the New Zealand User coded EMP033: "*Involving fire fighting personnel in regular familiarizations of fire protection equipment and undertake fire drills / simulations is an important aspect to ensure appropriate understanding of equipment and fire fighting procedures*."
-An example of comment for the Grouping C [Focus on training on emergency conditions, not only fire] given by the American User coded EMP055: "*Training for all hazards, not just fire hazards*."
-The comment for the Grouping C [Responsibility transferred to official Firemen (state owned)] given by the Polish User coded EMP053: "*The Company relies on state-owned Fire Brigade*."
All original comments can be seen in the corresponding annex.

[Back to Index] [Go to Annex]

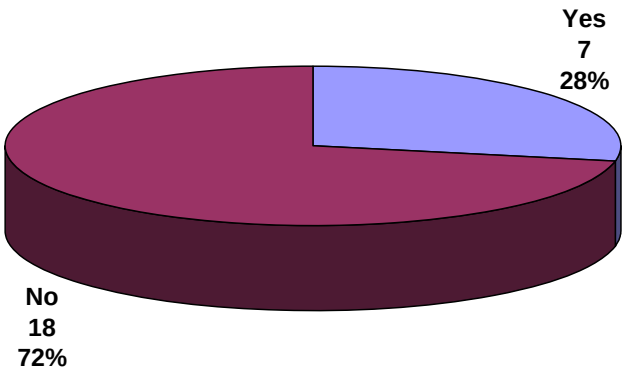
D 1.20 -

1.20) Considering the existence of the recently launched standards (for instance NFPA 851), is there a need of any additional specific international standard on generator fire protection? ☐ - Yes ☐ - No Any additional comment? Please state here:

This question was first stated as check-box and there was a call for additional comments which generated an open question.

Staring with the check-box question:

1.20) Considering the existence of the recently launched standards (for instance NFPA 851), is there a need of any additional specific international standard on generator fire protection?



This survey has 10 Blank answers – not considered in the graph.

The majority of the Users do not need any additional specific international Standard for GFP.

[Back to Index] [Go to Annex]

Open question analysis results (any additional comment?):
The correlated open question got the following results:

1.20) Considering the existence of the recently launched standards (for instance NFPA 851), is there a need of any additional specific international standard on generator fire protection? Any additional comment? Please state here:		
Grouping A	Published guidelines would be very useful	1
Grouping B	Not yet, the subject has to be discussed in a forum	1
Grouping C	The NFPA 851 Standard is not descriptive enough	1
Grouping D	This subject should be discussed in a special CIGRÉ meeting	1
Grouping E	Not familiar with the indicated standard, has no idea or not considered.	4
Grouping F	Believe that GFP is not necessary	1
Grouping G	Answer does not match the subject asked	2
	Total of answered questions	**11**

From the coherent answers we can reproduce the following comments on this issue:
-The comment for the Grouping A given by the New Zealand User coded : "*Published guidelines would be very useful that recommended suitable generator fire protection schemes based on generator design aspects and generator enclosure design aspects*."
-The comment for the Grouping B given by the Brazilian company coded EMP013: "*Not yet. The first step is being done and is the creation a forum about the adoption of systems for fire extinction within hydro generators housings in order to discuss its advantages, disadvantages, economic aspects, maintenance and operation.*"
-The following comment for the Grouping C given by the Australian User coded EMP039: "*We felt that it is a high level document and not descriptive enough to make decisions. Our fire protection decisions are based on risk (safety, finance, legal, environmental, community standing etc). We have to make decisions on a) whether to have a fire protection or not, b) if fir protection is needed should it be automatic or manual triggering, c) if automatic what should be the triggers, d) guide lines for selecting extinguishing materials etc.*"

-The comment for the Grouping D given by the Chinese User coded EMP021: "*We propose to organize a special meeting for discussion this topic, or as a routine, this subject will be discussed in the generator group meeting in CIGRE annual meeting.*"

[Back to Index] [Go to Annex]

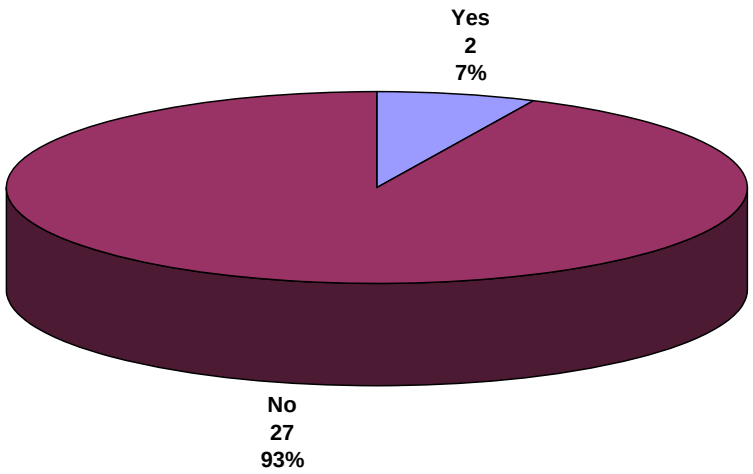
D 1.21 -

1.21) According to your opinion, is there any question that is missing in this part of the questionnaire? ☐ - Yes ☐ - No If yes, please state it here:

This final question give the opportunity to suggest missing items and was stated in two steps, firs a check-box question and for the Yes answers an open question to receive specific suggestions.

Starting with the check-up question:

1.21) According to your opinion, is there any question that is missing in this part of the questionnaire?



This survey has 6 Blank answers – not considered in the graph.

As a first result it is possible to say that the participant Users are satisfied with the questions stated with the questionnaire.

[Back to Index] [Go to Annex]

Open question analysis results (If yes, please state it here):
On the open question part of this question searching for comments from those who answered yes to the former question we got:
-The comment given by the Brazilian User coded EMP016: "*According to your opinion, is absolutely necessary to install a fire extinguishing system in large hydro generators? (Yes or No) If yes, please specify here why: If no, please specify here why*:"
-The comment given by the Brazilian User coded EMP016: "*For companies that adopt "GFP" should be questioned more about the maintenance and renewal policy of these systems.*"

[Back to Index] [Go to Annex]

SPECIAL NOTE: at this moment the Convener would like to thank to all participant Users for the excellent contributions given to the community

by means of their answers. We than for the time and valuable knowledge shown up to now!

<u>Annexes</u> D) The original complete statistical tables that support the item D of this Initial Draft

The numbering of the following tables do correspond to that of the corresponding questionnaires and appear also in the correlated graphics and tables stated above.

D 1.1 Check-Box

1.1) Are there standards recommending generator fire protection (GFP) in your country?					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	0	1	0	0
New Zealand	**2**	0	2	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	1	2	0	0
Sweden	**4**	0	3	1	0
Norway	**1**	0	1	0	0
Canada	**3**	1	2	0	0
China	**1**	1	0	0	0
Spain	**1**	1	0	0	0
Russia	**1**	1	0	0	0
Japan	**3**	0	3	0	0
Germany	**1**	0	1	0	0
Brazil	**7**	0	7	0	0
United States	**1**	1	0	0	0
Mexico	**2**	2	0	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**8**	**22**	**1**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	1	0	0	0
Macedonia	**1**	1	0	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	2	0	0
Total Observer Members (4)	**4**	**2**	**2**	**0**	**1**
Total Sum (20)	**35**	**10**	**24**	**1**	**3**

[Back to Question]

D 1.1.1 Open Question

Question	**Company**	**Result**	
		Answer	**Countries:**
1.1.1) If yes, which standards are these?	EMP005 (Switzerland)		
	EMP006 (Switzerland)		
	EMP008 (Brazil)		
	EMP009 (Japan)		
	EMP010 (Canada)		
	EMP012 (Mexico)	CFE XXA00-19, Sistema de protección contra incendio de centrales termoeléctricos	Mexico
	EMP013 (Brazil)		

	EMP015 (New Zealand)		
	EMP016 (Brazil)		
	EMP019 (Sweden)		
	EMP020 (Brazil)		
	EMP021 (China)	GB50219for water spray fire extinguishing equipment and GB50193 for CO2.	China
	EMP023 (Spain)	Included on UNE EN 60034	Non local Standards
	EMP025 (Brazil)		
	EMP026 (Sweden)		
	EMP027 (Macedonia)	Standar JUS accepted by R. Macedonia after the split from former Yuguslavia to sperated Repubics, now this is a national Macedonian Standard.	Macedonia
	EMP028 (Japan)		
	EMP031 (Mexico)	CFE XXAOO-19, sistema de proteccion contra incendios de centrales electricas	Mexico
	EMP032 (Canada)	National Fire Protection Association NFPA 850 and 851), Manitoba Hydro Fire Manual, Factory Mutual Loss Data Sheets, & Best Industry Practices. First of all Factory Mutual Global is our Corporate (Manitoba Hydro) insurer. A member of FM Global also serves on the NFPA 850, 851, and 853 Committees. Therefore, I have direct and indirect affiliation with the FM Global. In Canada, the National Fire Code references back to the NFPA Codes and Standards and therefore, they are regarded as mandatory. We follow these NFPA Codes and Standards very diligently, unless otherwise, over ruled by an Authority Having Jurisdiction (AHJ).	Canada
	EMP033 (New Zealand)		
	EMP036 (Canada)		
	EMP037 (Russia)	GOST 5616-89	Russia
	EMP038 (Sweden)		
	EMP039 (Australia)		
	EMP040 (Norway)		
	EMP043 (Japan)		
	EMP045 (Brazil)		
	EMP047 (Sweden)		
	EMP048 (Germany)		
	EMP051 (Austria)		
	EMP053 (Poland)	Local fire protection regulations	Polonia
	EMP054 (Austria)		
	EMP055 (EUA)	NFPA - 851 and internal agency regulations	USA
	EMP056 (Switzerland)	VKF, VDS	Switzerland
	EMP058 (Brazil)		

[Back to Question]

D 1.2 Check box

1.2) Do you recommend or install generator fire protection?					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	1	0	0	0

New Zealand	**2**	2	0	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	3	0	0	0
Sweden	**4**	0	3	1	0
Norway	**1**	0	1	0	0
Canada	**3**	3	0	0	0
China	**1**	1	0	0	0
Spain	**1**	0	1	0	0
Russia	**1**	1	0	0	0
Japan	**3**	2	1	0	0
Germany	**1**	1	0	0	0
Brazil	**7**	5	2	0	0
United States	**1**	1	0	0	0
Mexico	**2**	2	0	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**22**	**8**	**1**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	1	0	0	0
Macedonia	**1**	0	0	1	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	1	1	0
Total Observer Members (4)	**4**	**1**	**1**	**2**	**1**
Total Sum (20)	**35**	**23**	**9**	**3**	**3**

[Back to Question]

D 1.2.1 Open question

Question	Company	Answer	Coding
1.2.1) What are the reasons for that?	EMP005 (Switzerland)	Safety	Grouping A
	EMP006 (Switzerland)	Safety reasons	Grouping A
	EMP012 (Mexico)	Por seguridad	Grouping A
	EMP016 (Brazil)	Mainly personnel safety.	Grouping A
	EMP031 (México)	seguridad y proteccion de instalaciones y personal	Grouping A
	EMP008 (Brazil)	By observed occurrence around the world	Grouping B
	EMP009 (Japan)	We do not install GFP, because we use fireproof insulating material for generator coil. We have not had experience of generator fire.	Grouping C

	EMP013 (Brazil)	A CEMIG não adota os "GPF1)Os projetos atuais aplicam materiais termicamente mais resistentes, auto- extinguíveis e não propagantes ao fogo" (classe "F"); 2)As proteções digitais proporcionam uma rápida detecção das causas eletromecânicas/ dielétricas e eliminação destas em poucos ciclos além do fato, de possuirem redundância e, também, retaguardas; 3)Os cortes das fontes das fontes de energia elétrica, principal contribuinte na geração do calor e focos de incêndio, são instantâneos; 4)Uma atuação indevida ou intempestivas de um "GFP" pode cacausar longas indisponibilidades da unidade geradora; 5)As construções de compartimentos estanques para hidrogeradores; 6) Adoção de uma política de operação e manutenção adequada e por fim; 7)Desde a sua fundação (1952) e possuindo atualmente mais de 50 unidades de produção em operação não há qualquer registro de incêndio dentro do compartimento de um hidrogerador .	Grouping C
	EMP019 (Sweden)	Not any more when the winding are made of not burnable material.	Grouping C
	EMP026 (Sweden)	No need	Grouping C
	EMP040 (Norway)	Modern epoxy based stator winding insulation	Grouping C
	EMP051 (Austria)	Local structure	Grouping C
	EMP054 (Austria)	We rely on fire prevention by using self extinguishing and flame retardant insulating material and brazing.	Grouping C
	EMP010 (Canada)	Protection of the generating equipment	Grouping D
	EMP025 (Brazil)	Generator protection in the event of severe electrical faults. Hazards minimization Personnel protection	Grouping D
	EMP037 (Russia)	Fire protection	Grouping D
	EMP055 (EUA)	Protection of the equipment and power plant	Grouping D
	EMP056 (Switzerland)	Objektschutz und Personenschutz	Grouping D
	EMP015 (New Zealand)	Mainly an insurance requirement, but from personal experience all generator fires have gone out once the energy source has been removed	Grouping E
	EMP053 (Poland)	Mainly due to that insurance company insists to do it rather than to reduce scope of damages.	Grouping E
	EMP028 (Japan)	The fire extinction at the first stage is important for the generator to prevent a fire spread.	Grouping F
	EMP032 (Canada)	Protect the propagation of fire and damage to stator & rotor and associated structure	Grouping F
	EMP033 (New Zealand)	Prevent major damage to generators, minimize risks to personnel on site, and minimize risks of generator fire spread to other parts of the powerhouse. Appropriately designed and maintained generator fire protection systems are a good "insurance policy" to minimize fire damage to generators, and to ensure quick turnaround from a fire condition to return to generating service in as short a possible time. Without generating fire protection systems we would find ourselves at increased risk of fire damage, and also an increased risk of generator unit downtime due to fire damage. This is not a position we want to be in, and we see generator fire protection systems as a good risk mitigation measure.	Grouping F
	EMP036 (Canada)	Minimize the damage to the machine	Grouping F
	EMP039 (Australia)	Risk of loss justifies the expenditure. (Each unit is assessed based on risk, likelihood of fire and consequence and cost of installing fire protection. Safety of personnel was an additional factor in underground power stations.)	Grouping F

	EMP043 (Japan)	Generator fire protection prevents the fire from spreading in the generator.	Grouping F
	EMP045 (Brazil)	The reasons are decrease the damage and consequences in case of fire, therefore to minimize the chance of human injury and time to repair of the equipment.	Grouping F
	EMP048 (Germany)	Large damage and danger for persons in case of fire.	Grouping F
	EMP021 (China)	To guarantee the generator operation in reliability and safety as well as to decrease and shorten the extinction and duration of short circuit accident in minimize.	Grouping G
	EMP023 (Spain)	Nowadays, fire protection systems are being removed with the programmed rewinding processes of the generators, and it is recommended fireproof insulations.	Grouping H
	EMP038 (Sweden)	Did not answer	Grouping I
	EMP027 (Macedonia)	Fire protection is not necessary for power of generator less than 10 MVA . For the power of generator more than 10 MVA fire protection is recommended by actual standards. According our long period of operation (more than 50 years) and experience with 9 generators, this obligation from the standard should be discussed.	Grouping J
	EMP047 (Sweden)	We only use fire protection on asphalt and schellak insulation system. We don use fire protection on generator windings with epoxy insulation systems.	Grouping K

Summary

Grouping	Legend	Quantity
Grouping A	Safety (and safety reasons)	5
Grouping B	By observed occurrences	1
Grouping C	Do not install	7
Grouping D	Protection	5
Grouping E	Insurance (company) requirement	2
Grouping F	Reduce or minimize damages	8
Grouping G	Safety and reduce damages	1
Grouping H	In process of removing GFP	1
Grouping I	Did not answer	1
Grouping J	Smaller than 10 MVA not; bigger yes	1
Grouping K	Only for asphalt and shellak insulation system otherwise not	1

[Back to Question]

D 1.3 Check-Box

1.3) Is there any difference between the present and past fire protection strategies on generators in your organization?

Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	**1**	1	0	0	0
New Zealand	**2**	2	0	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	1	2	0	0
Sweden	**4**	2	2	0	0
Norway	**1**	1	0	0	0
Canada	**3**	2	1	0	0
China	**1**	0	1	0	0
Spain	**1**	1	0	0	0
Russia	**1**	0	1	0	0
Japan	**3**	2	1	0	0
Germany	**1**	1	0	0	0

Brazil	**7**	1	6	0	0
United States	**1**	0	1	0	0
Mexico	**2**	2	0	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**16**	**15**	**0**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0
Macedonia	**1**	1	0	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	1	1	0	0
Total Observer Members (4)	**4**	**2**	**2**	**0**	**1**
Total Sum (20)	**35**	**18**	**17**	**0**	**3**

[Back to Question]

D 1.3.1 Open question

Question	Company	Answer	Coding
1.3.1) If your organization changed the protection strategy, what are the reasons for the change?	EMP010 (Canada)	There are no plans to change the existing protection strategy.	Grouping A
	EMP045 (Brazil)	Basically the organization uses the same strategy from de Eighties.	Grouping A
	EMP009 (Japan)	We removed FGP, because the improvement of quality of insulator reduced the number of generator fire.	Grouping B
	EMP019 (Sweden)	see 1.2.1	Grouping B
	EMP023 (Spain)	At the same time of the refurbishment and rewinding of the generators, the fire protection systems are being removed because its maintenance costs.	Grouping B
	EMP054 (Austria)	Removing CO2 fire fighting plants (hazard for staff), replacing flammable material by flame retardant and self extinguishing material, brazing of stator windings instead of soft soldering.	Grouping B
	EMP012 (Mexico)	Se utilizaba gas halón, se cambio por normaitva ambiental, se cambió a CO2 y finalmente se utilizó agua en cabezales, implementado en forma manual	Grouping C
	EMP036 (Canada)	We are now using water instead of CO2. Water is not an asphyxiant. Personnel may be in pit.	Grouping C
	EMP039 (Australia)	In the past we had CO2 protection on all our units. Moving from CO2 to water based protection on the basis of safety and effectiveness of existing CO2 systems. Now we are in the process of installing water based fire protection only on some generators based on risk analysis.	Grouping C
	EMP027 (Macedonia)	Many unnecessary activation of fire protection of generator	Grouping D
	EMP015 (New Zealand)	Effectiveness and safety	Grouping E
	EMP021 (China)	The availability and effectiveness.	Grouping E
	EMP031 (Mexico)	mejorar y actualizar los sistemas existentes a CO2 y espuma	Grouping E

	EMP025 (Brazil)	Itaipu's fire detection system is composed of thermal and smoke detectors. CO2 is discharged whenever a thermal detector and a smoke detector operate. A first change was introduced in order to allow the fire protection system operation in the event of severe faults which could cause the opening of the generator doors and hatches. In 1992, due to an explosion caused by a stator fault, the generator doors opened and their micros witches blocked the fire protection system operation. In order to allow the future operation of the fire protection system in the case of severe faults, the phase differential (87G) and turn-to-turn (87SP) protections were connected in parallel with the micro switches. A second change was introduced due to an improper operation of one generator fire protection system in 2007. The release of CO2 and the generator trip were caused by a thermal and a smoke detector incorrect operation. In order to prevent this kind of incorrect behavior, the fire protection system control panel output was connected in series with protections 87G and 87SP.	Grouping F
	EMP028 (Japan)	For reducing the human damage in consideration, CO2 is no longer applied to the fire extinguishing system.	Grouping G
	EMP032 (Canada)	Depends on the type of windings, i.e. Themosetting versus Thermoplastic	Grouping H
	EMP040 (Norway)	Change from bitumen based to modern epoxy or polyester based stator winding insulation	Grouping H
	EMP047 (Sweden)	The strategy was changed when we started to install epoxy insulated windings (in th of 1960).	Grouping H
	EMP048 (Germany)	New materials of winding insulation	Grouping H
	EMP033 (New Zealand)	More focus on reducing fire risks to personnel, rather than focusing on the generating plant alone	Grouping I
	EMP055 (EUA)	Personnel safety and environmental considerations	Grouping I
	EMP056 (Switzerland)	früher nur Objektschutz, heute zusätzllich Personenschutz	Grouping I
	EMP043 (Japan)	We will change the protection strategy when we find the important defect on fire protection.	Grouping J
	EMP008 (Brazil)	not applicable	Grouping K
	EMP005 (Switzerland)	Did not answer	Grouping L
	EMP006 (Switzerland)	Did not answer	Grouping L
	EMP013 (Brazil)	Did not answer	Grouping L
	EMP016 (Brazil)	Did not answer	Grouping L
	EMP026 (Sweden)	Did not answer	Grouping L
	EMP037 (Russia)	Did not answer	Grouping L
	EMP038 (Sweden)	Did not answer	Grouping L
	EMP051 (Austria)	Did not answer	Grouping L
	EMP053 (Poland)	Did not answer	Grouping L

Summary

Grouping	Legend	Quantity
Grouping A	No Changes	2
Grouping B	Remove GFP with use of new insulation material	4
Grouping C	Implement water	3
Grouping D	To prevent unnecessary releases	1
Grouping E	To improve availability and effectiveness	3
Grouping F	Improvement in detection	1
Grouping G	Removing CO2	1
Grouping H	Changes depend upon insulation type	4

Grouping I	Focus on man security and environment	3
Grouping J	Changes will depend on GFP behavior	1
Grouping K	Not applicable	1
Grouping L	Did not answer	9

[Back to Question]

D 1.3.2 Open question

1.3.2) Do you intend to change the existing generator fire protection strategy in future and if so please give the reasons.	EMP009 (Japan)	No, we do not install FGP anymore.	Grouping A
	EMP010 (Canada)	No	Grouping A
	EMP012 (Mexico)	No	Grouping A
	EMP016 (Brazil)	No.	Grouping A
	EMP019 (Sweden)	see 1.2.1	Grouping A
	EMP025 (Brazil)	No	Grouping A
	EMP026 (Sweden)	No	Grouping A
	EMP027 (Macedonia)	no, to change the isolation of windings needs a lot of money.	Grouping A
	EMP031 (Mexico)	no	Grouping A
	EMP033 (New Zealand)	No	Grouping A
	EMP036 (Canada)	No	Grouping A
	EMP037 (Russia)	No.	Grouping A
	EMP039 (Australia)	Our existing strategy has been developed recently and in the process of implementation.	Grouping A
	EMP040 (Norway)	No, we do not expect any need for strategy change.	Grouping A
	EMP043 (Japan)	We will not change the existing generator fire protection strategy.	Grouping A
	EMP045 (Brazil)	Nowadays there isn't the intention of changing the protection strategy at Tractebel Energia (Brazil)	Grouping A
	EMP051 (Austria)	No	Grouping A
	EMP053 (Poland)	No	Grouping A
	EMP015 (New Zealand)	In the process of removing CO2 and installing water fogging systems with VESDA detection	Grouping B
	EMP021 (China)	We intend eliminate the fire protection equipment for the medium and small size generator in future due to above reasons. But it is under consideration and investigation.	Grouping C
	EMP023 (Spain)	As it has been mentioned, fire protection systems have been removed according to the generator rewinding program depending on the age of the stator and according to the conditions of the insulation. At the same time of the rewinding process, insulations are removed using new fireproof materials.	Grouping D
	EMP048 (Germany)	Yes, in case of refurbishment.	Grouping D
	EMP032 (Canada)	Depends on the type of windings and air cooled versus water cooled units	Grouping E
	EMP047 (Sweden)	Yes. We will gradually remove the CO2 systems because of the personal risk.	Grouping F
	EMP008 (Brazil)	not applicable	Grouping G
	EMP028 (Japan)	CO2 is not applied to extinguishing system to reduce the risk of the human damage and the environmental load in consideration.	Grouping G
	EMP055 (EUA)	Under study at this time. Reasons include maintenance requirements of current system, personnel safety, cost, and new insulation systems in generators.	Grouping H

	EMP056 (Switzerland)	siehe 1.3.1	Grouping H
	EMP005 (Switzerland)	Did not answer	Grouping I
	EMP006 (Switzerland)	Did not answer	Grouping I
	EMP013 (Brazil)	Did not answer	Grouping I
	EMP038 (Sweden)	Did not answer	Grouping I
	EMP054 (Austria)	Did not answer	Grouping I

Legends of the Groupings of Answers

Grouping	Legend	Quantity
Grouping A	No, no changes	18
Grouping B	Installing water + VESDA	1
Grouping C	Studying the elimination of GFP for small and medium units	1
Grouping D	Changing insulation and removing GFP	2
Grouping E	Depends of machine type	1
Grouping F	Removal of CO2	1
Grouping G	Not applicable	2
Grouping H	Formerly only equipment protection, nowadays personnel security, maintenance aspects, costs, new materials.	2
Grouping I	Did not answer	5

[Back to Question]

D 1.3.3 Check-Box

1.3.3) Do you have a single generator fire protection strategy to cover all the generators or do you have different strategies to cover different generators based on various factors? Please tick the relevant box:

Regular Members	Answers	Single strategy	Multiple strategies	Blank	N. Answ
Australia	**1**	0	1	0	0
New Zealand	**2**	1	1	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	0	3	0	0
Sweden	**4**	1	3	0	0
Norway	**1**	0	1	0	0
Canada	**3**	2	1	0	0
China	**1**	1	0	0	0
Spain	**1**	0	1	0	0
Russia	**1**	0	1	0	0
Japan	**3**	2	1	0	0
Germany	**1**	0	1	0	0
Brazil	**7**	4	3	0	0
United States	**1**	1	0	0	0
Mexico	**2**	0	2	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**12**	**19**	**0**	**2**
Observer Members	**Answers**	**Single strategy**	**Multiple strategies**	**Blank**	**N. Answ**
Poland	**1**	1	0	0	0
Macedonia	**1**	1	0	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	2	0	0
Total Observer Members (4)	**4**	**2**	**2**	**0**	**1**
Total Sum (20)	**35**	**14**	**21**	**0**	**3**

[Back to Question]

D 1.3.3.1 Consolidated

1.3.3.1) If your organization has multiple strategies to cover fire protection of different generators please tick and give brief explanation of the factors which contributed to use different strategies, as follows:

Company	Count of the considered examples	1.3.3.1.1) Generator Capacity (MVA)	1.3.3.1.2) Insulation Type (epoxy, polyester, bitumen etc)	1.3.3.1.3) Insulation Temperature Class (Class B, Class F etc)	1.3.3.1.4) Location (remote, underground, surface etc)	1.3.3.1.5) Cooling media (air, windings water cooled, etc)	1.3.3.1.6) Winding design features (roebel, multiturn, soft solder joints etc)	1.3.3.1.7) Generator Age	1.3.3.1.8) Contamination (carbon dust, oil vapor etc)	1.3.3.1.9) Other factors
EMP005 (Switzerland)	1	1	0	0	1	0	0	0	0	0
EMP006 (Switzerland)	1	0	1	0	0	1	0	0	1	1
EMP008 (Brazil)	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
EMP009 (Japan)	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
EMP010 (Canada)	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
EMP012 (Mexico)	1	1	0	0	0	0	0	0	0	0
EMP013 (Brazil)	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
EMP015 (New Zealand)	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
EMP016 (Brazil)	1	1	0	0	0	0	0	0	0	0
EMP019 (Sweden)	1	0	1	0	0	0	0	0	0	1
EMP020 (Brazil)	1	0	0	0	0	0	0	0	0	1
EMP021 (China)	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
EMP023 (Spain)	1	1	1	0	0	1	0	1	0	0
EMP025 (Brazil)	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
EMP026 (Sweden)	1	0	1	0	0	0	0	0	0	0
EMP027 (Macedonia)	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
EMP028 (Japan)	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
EMP031 (Mexico)	1	1	1	1	0	1	1	1	1	1
EMP032 (Canada)	1	1	1	1	1	1	1	0	1	1
EMP033 (New Zealand)	1	1	0	0	1	0	0	0	0	0
EMP036 (Canada)	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
EMP037 (Russia)	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
EMP038 (Sweden)	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
EMP039 (Australia)	1	1	0	1	1	0	1	0	0	1
EMP040 (Norway)	1	0	1	0	0	0	0	0	0	0
EMP043 (Japan)	1	0	0	0	0	0	0	0	0	0
EMP045 (Brazil)	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
EMP047 (Sweden)	1	0	1	1	0	0	0	0	0	1
EMP048 (Germany)	1	0	1	0	0	0	0	1	0	0
EMP051 (Austria)	1	0	1	0	1	0	0	0	0	0
EMP053 (Poland)	1	NA	NA	NA	NA	NA	NA	NA	NA	NA

EMP054 (Austria)	1	0	1	0	0	0	1	0	0	0
EMP055 (United States)	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
EMP056 (Switzerland)	1	1	0	0	1	0	0	0	0	0
EMP058 (Brazil)	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
Yes	**35**	**9**	**11**	**4**	**6**	**4**	**4**	**3**	**3**	**7**
No	**-**	**10**	**8**	**15**	**13**	**15**	**15**	**16**	**16**	**12**
NA	**-**	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**16**
NA - either a single strategy user or no GFP installed										

[Back to Question]

D 1.3.3.1.1 Check-Box

1.3.3.1.1) Generator Capacity (MVA)					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	1	0	0	0
New Zealand	**2**	1	0	1	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	2	1	0	0
Sweden	**4**	0	3	1	0
Norway	**1**	0	1	0	0
Canada	**3**	1	0	2	0
China	**1**	0	1	0	0
Spain	**1**	1	0	0	0
Russia	**1**	0	0	1	0
Japan	**3**	0	1	2	0
Germany	**1**	0	1	0	0
Brazil	**7**	1	1	5	0
United States	**1**	0	0	1	0
Mexico	**2**	2	0	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**9**	**9**	**13**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	0	1	0
Macedonia	**1**	0	0	1	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	2	0	0
Total Observer Members (4)	**4**	**0**	**2**	**2**	**1**
Total Sum (20)	**35**	**9**	**11**	**15**	**3**

[Back to Question]

D 1.3.3.1.1 Open question

Question	Company	Answer	Coding
1.3.3.1.1) Generator Capacity (MVA) Brief explanation note:	EMP005 (Switzerland)	No protection on small sizes	A
	EMP006 (Switzerland)	Blank	E
	EMP008 (Brazil)	Blank	E
	EMP009 (Japan)	Blank	E
	EMP010 (Canada)	Blank	E
	EMP012 (Mexico)	De acuerdo con el sistema de enfriamiento del generador, si el sistema de enfriamiento es abierto, no se aplica CO2 en forma automática.	B
	EMP013 (Brazil)	Blank	E
	EMP015 (New Zealand)	Blank	E
	EMP016 (Brazil)	Low capacity machines, with open air ventilation, have no fire protection system installed.	A
	EMP019 (Sweden)	Blank	E

	EMP020 (Brazil)	Blank	E
	EMP021 (China)	include all the generators with capacity 12.5 MVA or above.	A
	EMP023 (Spain)	Generator larger than 60MVA	A
	EMP025 (Brazil)	Blank	E
	EMP026 (Sweden)	Blank	E
	EMP027 (Macedonia)	Blank	E
	EMP028 (Japan)	Blank	E
	EMP031 (Mexico)	en sistemas de enfriamiento cerrados aplicamos CO2 y en abiertos espuma.	B
	EMP032 (Canada)	Same reasoning as sted in above questions 1.3.1 &1.3.2	D
	EMP033 (New Zealand)	All of Meridian's hydroelectric generators above 10 MVA capacity have a generator gaseous fire extinguishing system	A
	EMP036 (Canada)	Blank	E
	EMP037 (Russia)	Blank	E
	EMP038 (Sweden)	Blank	E
	EMP039 (Australia)	As this impacts on loss consequences- higher business impact.	D
	EMP040 (Norway)	Blank	E
	EMP043 (Japan)	Blank	E
	EMP045 (Brazil)	Blank	E
	EMP047 (Sweden)	Blank	E
	EMP048 (Germany)	Blank	E
	EMP051 (Austria)	Blank	E
	EMP053 (Poland)	Blank	E
	EMP054 (Austria)	Blank	E
	EMP055 (United States)	Blank	E
	EMP056 (Switzerland)	smaller then 10 MVA or built in closed housing	C
	EMP058 (Brazil)	Blank	E

Summary

Grouping	Legend	Quantity
Grouping A	Consider a minimum power limit to install GFP	5
Grouping B	Consider if it is an open unit (not applied) or a closed (apply)	2
Grouping C	Considering A+B	1
Grouping D	Answer does not match the subject asked	2
Grouping E	Blank	25
Total of answered questions		**35**

[Back to Question]

D 1.3.3.1.2 Check Box

1.3.3.1.2) Insulation Type (epoxy, polyester, bitumen etc)					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	0	1	0	0
New Zealand	**2**	0	1	1	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	1	2	0	0
Sweden	**4**	3	0	1	0
Norway	**1**	1	0	0	0
Canada	**3**	1	0	2	0
China	**1**	0	1	0	0
Spain	**1**	1	0	0	0
Russia	**1**	0	0	1	0
Japan	**3**	0	1	2	0
Germany	**1**	1	0	0	0
Brazil	**7**	0	2	5	0

United States	**1**	0	0	1	0
Mexico	**2**	1	1	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**9**	**9**	**13**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	0	1	0
Macedonia	**1**	0	0	1	0
Belgium	**0**	0	0	0	1
Austria	**2**	2	0	0	0
Total Observer Members (4)	**4**	**2**	**0**	**2**	**1**
Total Sum (20)	**35**	**11**	**9**	**15**	**3**

[Back to Question]

D 1.3.3.1.2 Open question

Question	Company	Answer	Coding
1.3.3.1.2) Insulation Type (epoxy, polyester, bitumen etc) Brief explanation note:	EMP005 (Switzerland)	Blank	F
	EMP006 (Switzerland)	Blank	F
	EMP008 (Brazil)	Blank	F
	EMP009 (Japan)	Blank	F
	EMP010 (Canada)	Blank	F
	EMP012 (Mexico)	Blank	F
	EMP013 (Brazil)	Blank	F
	EMP015 (New Zealand)	Blank	F
	EMP016 (Brazil)	Blank	F
	EMP019 (Sweden)	Blank	F
	EMP020 (Brazil)	Blank	F
	EMP021 (China)	Blank	F
	EMP023 (Spain)	At the same time of rewinding process, epoxy insulations are installed and the fire protection systems are removed	D
	EMP025 (Brazil)	Blank	F
	EMP026 (Sweden)	Blank	F
	EMP027 (Macedonia)	Blank	F
	EMP028 (Japan)	Blank	F
	EMP031 (Mexico)	poliester y epoxica	E
	EMP032 (Canada)	Same as 1.3.1	D
	EMP033 (New Zealand)	Blank	F
	EMP036 (Canada)	Blank	F
	EMP037 (Russia)	Blank	F
	EMP038 (Sweden)	CO2 when it is Bitumen	C
	EMP039 (Australia)	We do not consider that likelihood or consequences of fire greatly increased by type of ground insulation material	B
	EMP040 (Norway)	Some old generators still have old bitumen based winding insulation	E
	EMP043 (Japan)	Blank	F
	EMP045 (Brazil)	Blank	F
	EMP047 (Sweden)	No protection on Epoxy class F, after a fault the unit will trip. On asphalt and schellak windings class B there will be a fire detection system and depending on the relay protection system some will have CO2 protection (most of the units have CO2) and some will go to stop.	D
	EMP048 (Germany)	New generators gets a fire resistant insulation	A
	EMP051 (Austria)	Blank	F
	EMP053 (Poland)	Blank	F
	EMP054 (Austria)	Blank	F
	EMP055 (United States)	Blank	F

	EMP056 (Switzerland)	Blank	F
	EMP058 (Brazil)	Blank	F

Summary

Grouping	Legend	Quantity
Grouping A	With epoxy insulation no GFP	1
Grouping B	Do not consider that likelihood or consequences of fire greatly increased by type of ground insulation material	1
Grouping C	With bitumen insulation is mandatory	1
Grouping D	Consider both A+C	3
Grouping E	Answer does not match the subject asked	2
Grouping F	Blank	27
Total of answered questions		**35**

[Back to Question]

D 1.3.3.1.3 Check-Box

1.3.3.1.3) Insulation Temperature Class (Class B, Class F etc)					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	1	0	0	0
New Zealand	**2**	0	1	1	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	0	3	0	0
Sweden	**4**	2	2	0	0
Norway	**1**	0	1	0	0
Canada	**3**	1	0	2	0
China	**1**	0	1	0	0
Spain	**1**	0	1	0	0
Russia	**1**	0	0	1	0
Japan	**3**	0	1	2	0
Germany	**1**	0	1	0	0
Brazil	**7**	0	2	5	0
United States	**1**	0	0	1	0
Mexico	**2**	1	1	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**5**	**14**	**12**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	0	1	0
Macedonia	**1**	0	0	1	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	2	0	0
Total Observer Members (4)	**4**	**0**	**2**	**2**	**1**
Total Sum (20)	**35**	**5**	**16**	**14**	**3**

[Back to Question]

D 1.3.3.1.3 Open question

Question	Company	Result	
		Answer	Quant
1.3.3.1.3) Insulation Temperature Class (Class B, Class F etc) **Brief**	EMP005 (Switzerland)		0
	EMP0053 (Poland)		0
	EMP006 (Switzerland)		0
	EMP008 (Brazil)		0
	EMP009 (Japan)		0

explanation note:	EMP010 (Canada)		0
	EMP012 (Mexico)		0
	EMP013 (Brazil)		0
	EMP015 (New Zealand)		0
	EMP016 (Brazil)		0
	EMP019 (Sweden)		0
	EMP020 (Brazil)		0
	EMP021 (China)		0
	EMP023 (Spain)		0
	EMP025 (Brazil)		0
	EMP026 (Sweden)		0
	EMP027 (Macedonia)		0
	EMP028 (Japan)		0
	EMP031 (Mexico)	clase F y para los sistemas de enfriamiento cerrado es clase H	1
	EMP032 (Canada)		0
	EMP033 (New Zealand)		0
	EMP036 (Canada)		0
	EMP037 (Russia)		0
	EMP038 (Sweden)		0
	EMP039 (Australia)	We do not consider that likelihood of fire or consequences greatly increased by type of insulation temperature class or operating temperature	1
	EMP040 (Norway)		0
	EMP043 (Japan)		0
	EMP045 (Brazil)		0
	EMP047 (Sweden)		0
	EMP048 (Germany)		0
	EMP051 (Austria)		0
	EMP054 (Austria)		0
	EMP055 (EUA)		0
	EMP056 (Switzerland)		0
	EMP058 (Brazil)		0

[Back to Question]

D 1.3.3.1.4 Check-Box

1.3.3.1.4) Location (remote, underground, surface etc)					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	1	0	0	0
New Zealand	**2**	1	0	1	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	2	1	0	0
Sweden	**4**	0	3	1	0
Norway	**1**	0	1	0	0
Canada	**3**	1	0	2	0
China	**1**	0	1	0	0
Spain	**1**	0	1	0	0
Russia	**1**	0	0	1	0
Japan	**3**	0	1	2	0
Germany	**1**	0	1	0	0
Brazil	**7**	0	2	5	0
United States	**1**	0	0	1	0
Mexico	**2**	0	2	0	0

France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**5**	**13**	**13**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	0	1	0
Macedonia	**1**	0	0	1	0
Belgium	**0**	0	0	0	1
Austria	**2**	1	1	0	0
Total Observer Members (4)	**4**	**1**	**1**	**2**	**1**
Total Sum (20)	**35**	**6**	**14**	**15**	**3**

[Back to Question]

D 1.3.3.1.4 Open question

Question	Company	Result	
		Answer	Quant
1.3.3.1.4) Location (remote, underground, surface etc) **Brief explanation note:**	EMP005 (Switzerland)	Cavern mounted require highest safety	1
	EMP0053 (Poland)		0
	EMP006 (Switzerland)		0
	EMP008 (Brazil)		0
	EMP009 (Japan)		0
	EMP010 (Canada)		0
	EMP012 (Mexico)		0
	EMP013 (Brazil)		0
	EMP015 (New Zealand)		0
	EMP016 (Brazil)		0
	EMP019 (Sweden)		0
	EMP020 (Brazil)		0
	EMP021 (China)		0
	EMP023 (Spain)		0
	EMP025 (Brazil)		0
	EMP026 (Sweden)		0
	EMP027 (Macedonia)		0
	EMP028 (Japan)		0
	EMP031 (Mexico)	sistema en cascada exterior	1
	EMP032 (Canada)	Attended versus unattended stions and fire response time by a fire crew	1
	EMP033 (New Zealand)	The risks of a generator fire to personnel have higher consequences in underground power stations compared to surface power stations. We undertake a risk assessment to determine emergency egress times for personnel which is an input into deciding whether the generator fire protection system should employ a clean agent gas to minimise risks to personnel, or whether a CO2 system would be adequate.	1
	EMP036 (Canada)		0
	EMP037 (Russia)		0
	EMP038 (Sweden)		0
	EMP039 (Australia)	As this impacts on safety of personnel. We have decided to implement fire protection on two of our underground stations	1
	EMP040 (Norway)		0
	EMP043 (Japan)		0
	EMP045 (Brazil)		0
	EMP047 (Sweden)		0
	EMP048 (Germany)		0
	EMP051 (Austria)		0

	EMP054 (Austria)		0
	EMP055 (EUA)		0
	EMP056 (Switzerland)		0
	EMP058 (Brazil)		0

[Back to Question]

D 1.3.3.1.5 Check-Box

1.3.3.1.5) Cooling media (air, windings water cooled, etc)					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	0	1	0	0
New Zealand	**2**	0	1	1	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	1	1	1	0
Sweden	**4**	0	3	1	0
Norway	**1**	0	1	0	0
Canada	**3**	1	0	2	0
China	**1**	0	1	0	0
Spain	**1**	1	0	0	0
Russia	**1**	0	0	1	0
Japan	**3**	0	1	2	0
Germany	**1**	0	1	0	0
Brazil	**7**	0	2	5	0
United States	**1**	0	0	1	0
Mexico	**2**	1	1	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**4**	**13**	**14**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	0	1	0
Macedonia	**1**	0	0	1	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	2	0	0
Total Observer Members (4)	**4**	**0**	**2**	**2**	**1**
Total Sum (20)	**35**	**4**	**15**	**16**	**3**

[Back to Question]

D 1.3.3.1.5 Open question

Question	**Company**	**Result**	
		Answer	**Quant**
1.3.3.1.5) Cooling media (air, windings water cooled, etc) **Brief explanation note:**	EMP005 (Switzerland)		0
	EMP006(Switzerland)		0
	EMP008 (Brazil)		0
	EMP009 (Japan)		0
	EMP010 (Canada)		0
	EMP012 (Mexico)		0
	EMP013 (Brazil)		0
	EMP015 (New Zealand)		0
	EMP016 (Brazil)		0
	EMP019 (Sweden)		0
	EMP020 (Brazil)		0
	EMP021 (China)		0

	EMP023 (Spain)	All our hydro generators are air cooled.	1
	EMP025 (Brazil)		0
	EMP026 (Sweden)		0
	EMP027 (Macedonia)		0
	EMP028 (Japan)		0
	EMP031 (Mexico)	aire	1
	EMP032 (Canada)	Depends on the size and type of windings	1
	EMP033 (New Zealand)		0
	EMP036 (Canada)		0
	EMP037 (Russia)		0
	EMP038 (Sweden)	For generators with open circuit ventilation we use fire detectors to trip the unit	1
	EMP039 (Australia)	All oor generators are air cooled.	1
	EMP040 (Norway)		0
	EMP043 (Japan)		0
	EMP045 (Brazil)		0
	EMP047 (Sweden)		0
	EMP048 (Germany)	Only air cooled generators in operation in our business unit	1
	EMP051 (Austria)		0
	EMP053 (Poland)		0
	EMP054 (Austria)		0
	EMP055 (EUA)		0
	EMP056 (Switzerland)		0
	EMP058 (Brazil)		0

[Back to Question]

D 1.3.3.1.6 Check-Box

1.3.3.1.6) Winding design features (roebel, multiturn, soft solder joints etc)					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	1	0	0	0
New Zealand	**2**	0	1	1	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	0	3	0	0
Sweden	**4**	0	3	1	0
Norway	**1**	0	1	0	0
Canada	**3**	1	0	2	0
China	**1**	0	0	1	0
Spain	**1**	0	1	0	0
Russia	**1**	0	0	1	0
Japan	**3**	0	1	2	0
Germany	**1**	0	1	0	0
Brazil	**7**	0	2	5	0
United States	**1**	0	0	1	0
Mexico	**2**	1	1	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**3**	**14**	**14**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	0	1	0
Macedonia	**1**	0	0	1	0
Belgium	**0**	0	0	0	1
Austria	**2**	1	1	0	0

Total Observer Members (4)	**4**	**1**	**1**	**2**	**1**
Total Geral (20)	**35**	**4**	**15**	**16**	**3**

[Back to Question]

D 1.3.3.1.6 Open question

Question	Company	Result	
		Answer	**Quant**
1.3.3.1.6) Winding design features (roebel, multiturn, soft solder joints etc) **Brief explanation note:**	EMP005 (Switzerland)		0
	EMP006 (Switzerland)		0
	EMP008 (Brazil)		0
	EMP009 (Japan)		0
	EMP010 (Canada)		0
	EMP012 (Mexico)		0
	EMP013 (Brazil)		0
	EMP015 (New Zealand)		0
	EMP016 (Brazil)		0
	EMP019 (Sweden)		0
	EMP020 (Brazil)		0
	EMP021 (China)		0
	EMP023 (Spain)		0
	EMP025 (Brazil)		0
	EMP026 (Sweden)		0
	EMP027 (Macedonia)		0
	EMP028 (Japan)		0
	EMP031 (Mexico)	roebel	1
	EMP032 (Canada)		0
	EMP033 (New Zealand)		0
	EMP036 (Canada)		0
	EMP037 (Russia)		0
	EMP038 (Sweden)		0
	EMP039 (Australia)	as this impacts on greater likelihood of fires with multiturn and/or soft soldered strand joints	1
	EMP040 (Norway)		0
	EMP043 (Japan)		0
	EMP045 (Brazil)		0
	EMP047 (Sweden)	Most of our machines have roebel bars or one turn coil	1
	EMP048 (Germany)		0
	EMP051 (Austria)		0
	EMP053 (Poland)		0
	EMP054 (Austria)	soft soldered joint	1
	EMP055 (EUA)		0
	EMP056 (Switzerland)		0
	EMP058 (Brazil)		0

[Back to Question]

D 1.3.3.1.7 Check-Box

1.3.3.1.7) Generator Age					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	0	1	0	0

New Zealand	**2**	0	1	1	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	0	3	0	0
Sweden	**4**	0	3	1	0
Norway	**1**	0	1	0	0
Canada	**3**	0	1	2	0
China	**1**	0	1	0	0
Spain	**1**	1	0	0	0
Russia	**1**	0	0	1	0
Japan	**3**	0	1	2	0
Germany	**1**	1	0	0	0
Brazil	**7**	0	2	5	0
United States	**1**	0	0	1	0
Mexico	**2**	1	1	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**3**	**15**	**13**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	0	1	0
Macedonia	**1**	0	0	1	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	2	0	0
Total Observer Members (4)	**4**	**0**	**2**	**2**	**1**
Total Sum (20)	**35**	**3**	**17**	**15**	**3**

[Back to Question]

D 1.3.3.1.7 Open question

Question	Company	Result	
		Answer	Quant
1.3.3.1.7) Generator Age **Brief explanation note:**	EMP005 (Switzerland)		0
	EMP006 (Switzerland)		0
	EMP008 (Brazil)		0
	EMP009 (Japan)		0
	EMP010 (Canada)		0
	EMP012 (Mexico)		0
	EMP013 (Brazil)		0
	EMP015 (New Zealand)		0
	EMP016 (Brazil)		0
	EMP019 (Sweden)		0
	EMP020 (Brazil)		0
	EMP021 (China)		0
	EMP023 (Spain)	And depending on the insulation conditions.	1
	EMP025 (Brazil)		0
	EMP026 (Sweden)		0
	EMP027 (Macedonia)		0
	EMP028 (Japan)		0
	EMP031 (Mexico)	100 años	1
	EMP032 (Canada)		0
	EMP033 (New Zealand)		0
	EMP036 (Canada)		0
	EMP037 (Russia)		0
	EMP038 (Sweden)		0

	EMP039 (Australia)	We do not consider that likelihood of fire or consequences greatly increased by type of age as most of our generators falls into 30-50 year bracket.	1
	EMP040 (Norway)		0
	EMP043 (Japan)		0
	EMP045 (Brazil)		0
	EMP047 (Sweden)		0
	EMP048 (Germany)	Old generators don't have a resistant insulation	1
	EMP051 (Austria)		0
	EMP053 (Poland)		0
	EMP054 (Austria)		0
	EMP055 (EUA)		0
	EMP056 (Switzerland)		0
	EMP058 (Brazil)		0

[Back to Question]

D 1.3.3.1.8 Check-Box

1.3.3.1.8) Contamination (carbon dust, oil vapor etc)					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	0	1	0	0
New Zealand	**2**	0	1	1	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	1	2	0	0
Sweden	**4**	0	3	1	0
Norway	**1**	0	1	0	0
Canada	**3**	1	0	2	0
China	**1**	0	1	0	0
Spain	**1**	0	1	0	0
Russia	**1**	0	0	1	0
Japan	**3**	0	1	2	0
Germany	**1**	0	1	0	0
Brazil	**7**	0	2	5	0
United States	**1**	0	0	1	0
Mexico	**2**	1	1	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**3**	**15**	**13**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	0	1	0
Macedonia	**1**	0	0	1	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	2	0	0
Total Observer Members (4)	**4**	**0**	**2**	**2**	**1**
Total Sum (20)	**35**	**3**	**17**	**15**	**3**

[Back to Question]

D 1.3.3.1.8 Open question

Question	**Company**	**Result**	
		Answer	**Quant**
1.3.3.1.8) Contamination (carbon dust, oil vapor etc)	EMP005 (Switzerland)		0
	EMP006 (Switzerland)		0
	EMP008 (Brazil)		0

Brief explanation note:	EMP009 (Japan)		0
	EMP010 (Canada)		0
	EMP012 (Mexico)		0
	EMP013 (Brazil)		0
	EMP015 (New Zealand)		0
	EMP016 (Brazil)		0
	EMP019 (Sweden)		0
	EMP020 (Brazil)		0
	EMP021 (China)		0
	EMP023 (Spain)		0
	EMP025 (Brazil)		0
	EMP026 (Sweden)		0
	EMP027 (Macedonia)		0
	EMP028 (Japan)		0
	EMP031 (Mexico)	polvo de carbon y vapor de aceite	1
	EMP032 (Canada)		0
	EMP033 (New Zealand)		0
	EMP036 (Canada)		0
	EMP037 (Russia)		0
	EMP038 (Sweden)		0
	EMP039 (Australia)	We do not consider that likelihood of fire or consequences greatly increased by contamination on our generators	1
	EMP040 (Norway)		0
	EMP043 (Japan)		0
	EMP045 (Brazil)		0
	EMP047 (Sweden)		0
	EMP048 (Germany)		0
	EMP051 (Austria)		0
	EMP053 (Poland)		0
	EMP054 (Austria)		0
	EMP055 (EUA)		0
	EMP056 (Switzerland)		0
	EMP058 (Brazil)		0

[Back to Question]

D 1.3.3.1.9 Check-Box

1.3.3.1.9) Other factors					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	1	0	0	0
New Zealand	**2**	0	1	1	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	1	2	0	0
Sweden	**4**	2	1	1	0
Norway	**1**	0	1	0	0
Canada	**3**	1	0	2	0
China	**1**	0	1	0	0
Spain	**1**	0	1	0	0
Russia	**1**	0	0	1	0
Japan	**3**	0	1	2	0
Germany	**1**	0	1	0	0
Brazil	**7**	1	1	5	0

United States	**1**	0	0	1	0
Mexico	**2**	1	1	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**7**	**11**	**13**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	0	1	0
Macedonia	**1**	0	0	1	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	2	0	0
Total Observer Members (4)	**4**	**0**	**2**	**2**	**1**
Total Sum (20)	**35**	**7**	**13**	**15**	**3**

[Back to Question]

D 1.3.3.1.9 Open question

Question	Company	Answer	Coding
1.3.3.1.9) Other factors Please specify these other factors and give a brief explanation note:	EMP005 (Switzerland)	Blank	G
	EMP006 (Switzerland)	Bearing and horizontal / vertical generator	A
	EMP008 (Brazil)	not applicable	F
	EMP009 (Japan)	Blank	G
	EMP010 (Canada)	Blank	G
	EMP012 (Mexico)	Blank	G
	EMP013 (Brazil)	Blank	G
	EMP015 (New Zealand)	Blank	G
	EMP016 (Brazil)	Blank	G
	EMP019 (Sweden)	Enough relay protection to avoid fire	D
	EMP020 (Brazil)	The fire extinguishing method is one: through the CO2 application. However, there are different forms to deploy the discharge of the gas, which varies in function of the time in which the plant was constructed or even of the manufacturer of the machine. Basically, the application methods are the following ones: 1) The CO2 discharge and the machine stopping is triggered by the actuation of any one of these relays: 87G (differential) or 49C (thermostat); or 2) The CO2 discharge and the machine stopping is triggered by the actuation of the logic: 87G+ smoke detector or 87G+ temperature detector;	D
	EMP021 (China)	Blank	G
	EMP023 (Spain)	Blank	G
	EMP025 (Brazil)	Blank	G
	EMP026 (Sweden)	Blank	G
	EMP027 (Macedonia)	Blank	G
	EMP028 (Japan)	Blank	G
	EMP031 (Mexico)	humedad del 100%	E
	EMP032 (Canada)	Depends on Early warning detection or conventional detection	C
	EMP033 (New Zealand)	Blank	G
	EMP036 (Canada)	Blank	G
	EMP037 (Russia)	Blank	G
	EMP038 (Sweden)	Blank	G
	EMP039 (Australia)	Business consequences of Loss	B
	EMP040 (Norway)	Blank	G
	EMP043 (Japan)	Blank	G
	EMP045 (Brazil)	Blank	G
	EMP047 (Sweden)	Electrical system and relay protection. redundance, quality, fast relay etc.	D
	EMP048 (Germany)	Blank	G
	EMP051 (Austria)	Blank	G

	EMP053 (Poland)	Blank	G
	EMP054 (Austria)	Blank	G
	EMP055 (United States)	Blank	G
	EMP056 (Switzerland)	Blank	G
	EMP058 (Brazil)	Blank	G

Summary

Grouping	Legend	Quantity
Grouping A	Influence of bearing and if horizontal / vertical generator	1
Grouping B	Attention to business consequences of Loss	1
Grouping C	Depends on Early warning detection or conventional detection	1
Grouping D	Electrical system and relay protection. redundancy, quality, fast relay etc.	3
Grouping E	High humidity	1
Grouping F	Answer does not match the subject asked	1
Grouping G	Blank	27
Total of answered questions		**35**

[Back to Question]

D 1.4 Check-Box

Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	**1**	0	1	0	0
New Zealand	**2**	1	1	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	0	3	0	0
Sweden	**4**	0	3	1	0
Norway	**1**	0	1	0	0
Canada	**3**	2	1	0	0
China	**1**	1	0	0	0
Spain	**1**	0	1	0	0
Russia	**1**	0	1	0	0
Japan	**3**	1	2	0	0
Germany	**1**	0	1	0	0
Brazil	**7**	5	2	0	0
United States	**1**	0	1	0	0
Mexico	**2**	2	0	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**12**	**18**	**1**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	1	0	0	0
Macedonia	**1**	0	1	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	2	0	0
Total Observer Members (4)	**4**	**1**	**3**	**0**	**1**
Total Sum (20)	**35**	**13**	**21**	**1**	**3**

[Back to Question]

D 1.4.1 Open question

Question	Company	Answer	Coding
1.4.1) If yes, is there any specific generator fire protection type recommended? Please specify.	EMP005 (Switzerland)	Blank	F
	EMP006 (Switzerland)	Blank	F
	EMP008 (Brazil)	The requirement is the existence of a system, without determining the type of system	B
	EMP009 (Japan)	Blank	F

	EMP010 (Canada)	No to the best of our knowledge there was no type recommended.	B
	EMP012 (Mexico)	El seguro no especifica ningún sistema en especial	B
	EMP013 (Brazil)	CO2	A
	EMP015 (New Zealand)	No but they are happy with the water fog and VESDA combination that we are installing	B
	EMP016 (Brazil)	Blank	F
	EMP019 (Sweden)	Blank	F
	EMP020 (Brazil)	Blank	F
	EMP021 (China)	Normally there are only two type of water spray and CO2 fire protection.	E
	EMP023 (Spain)	Blank	F
	EMP025 (Brazil)	No	B
	EMP026 (Sweden)	Blank	F
	EMP027 (Macedonia)	Blank	F
	EMP028 (Japan)	Inert gas extinguishing system, halogen compound extinguishing system, dry-chemical extinguishing system or fire extinguisher	D
	EMP031 (Mexico)	el seguro no especifica el tipo de sistema.	B
	EMP032 (Canada)	Water recommended by insurer	C
	EMP033 (New Zealand)	Blank	F
	EMP036 (Canada)	Blank	F
	EMP037 (Russia)	Blank	F
	EMP038 (Sweden)	Blank	F
	EMP039 (Australia)	Blank	F
	EMP040 (Norway)	Blank	F
	EMP043 (Japan)	Blank	F
	EMP045 (Brazil)	There isn´t a specific protection type required. The insurance company and Tractebel has the same strategy of using CO2	B
	EMP047 (Sweden)	Blank	F
	EMP048 (Germany)	Blank	F
	EMP051 (Austria)	Blank	F
	EMP053 (Poland)	No specific type recommended	B
	EMP054 (Austria)	Blank	F
	EMP055 (United States)	Blank	F
	EMP056 (Switzerland)	Blank	F
	EMP058 (Brazil)	We recommend CO2 installation, concentrated in two containers, one reserve of other for all generators of the installation, automatic performance, digital controlled and supervised.	E

Summary

Grouping	Legend	Quantity
Grouping A	CO2	1
Grouping B	No, no specific system is recommended by a third party	8
Grouping C	Water is recommended by the insurer	1
Grouping D	Several systems are recommended	1
Grouping E	Answer does not match the subject asked	2
Grouping F	Blank	22
Total of answered questions		**35**

[Back to Question]

D 1.4.2 Check-Box

Regular Members	Answers	It is a must	No, in fact it implies in reduction of insurance costs	Blank	N. Answ

Australia	**1**	0	1	0	0
New Zealand	**2**	1	0	1	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	1	0	2	0
Sweden	**4**	0	2	2	0
Norway	**1**	0	0	1	0
Canada	**3**	0	2	1	0
China	**1**	1	0	0	0
Spain	**1**	0	0	1	0
Russia	**1**	0	0	1	0
Japan	**3**	1	1	1	0
Germany	**1**	0	1	0	0
Brazil	**7**	1	4	2	0
United States	**1**	0	0	1	0
Mexico	**2**	0	2	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**5**	**13**	**13**	**2**
Observer Members	**Answers**	**It is a must**	**No, in fact it implies in reduction of insurance costs**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0
Macedonia	**1**	0	0	1	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	1	1	0
Total Observer Members (4)	**4**	**0**	**2**	**2**	**1**
Total Sum (20)	**35**	**5**	**15**	**15**	**3**

[Back to Question]

D 1.4.2 Open question

Question	Company	Answer	Coding
Please comment:	EMP005 (Switzerland)	Safety has priority	H
	EMP006 (Switzerland)	Blank	I
	EMP008 (Brazil)	Blank	I
	EMP009 (Japan)	Blank	I
	EMP010 (Canada)	If no fire system was installed then the insurance premium would be higher.	C
	EMP012 (Mexico)	Ninguno	F
	EMP013 (Brazil)	A CEMIG não implanta o "GFP" e justifica junto ao orgão regulador Federal (ANEEL) e Seguradoras as motivações da não adoção de SPCI dentro dos compartimentos dos geradores.	A
	EMP015 (New Zealand)	Not absolutely clear and the there is no reduction in insurance cost but makes it easier to get groups interested in providing cover	D
	EMP016 (Brazil)	Blank	I
	EMP019 (Sweden)	Blank	I
	EMP020 (Brazil)	Blank	I
	EMP021 (China)	According to the regulation made by national fire protection authority.	B
	EMP023 (Spain)	Blank	I
	EMP025 (Brazil)	Blank	I
	EMP026 (Sweden)	Blank	I
	EMP027 (Macedonia)	Blank	I
	EMP028 (Japan)	Fire protection law controlls to install fire extinguisher.	B
	EMP031 (Mexico)	Blank	I

	EMP032 (Canada)	recommendation without reduction in the insurance premium	G
	EMP033 (New Zealand)	Blank	I
	EMP036 (Canada)	Blank	I
	EMP037 (Russia)	Blank	I
	EMP038 (Sweden)	Blank	I
	EMP039 (Australia)	Not a direct impact on Premiums with or without gen fire protection, attention not to get confused by the redaction of this question, because there in no insurance cost reduction involved.	G
	EMP040 (Norway)	Blank	I
	EMP043 (Japan)	Blank	I
	EMP045 (Brazil)	Tractebel´s strategy is to use generator fire protection for all the machines. Recently this strategy contributed for a reduction of costs in the contracts with the insurance company for all our power plants.	C
	EMP047 (Sweden)	Blank	I
	EMP048 (Germany)	It was checked by insurance.	E
	EMP051 (Austria)	Blank	I
	EMP053 (Poland)	It is also easier and simpler to get money from insurance company in case of any accident.	D
	EMP054 (Austria)	Blank	I
	EMP055 (United States)	Blank	I
	EMP056 (Switzerland)	Blank	I
	EMP058 (Brazil)	The use of fire protection is only for insurance price reduction. In our experience, the use of class F insulation and the very fast protection performance make fire protection useless.	C

Summary

Grouping	Legend	Quantity
Grouping A	Does not use and justifies towards the authorities and insurance company	1
Grouping B	Installation of GFP is regulated by the authorities in charge, or is regulated by Law	2
Grouping C	Implies in an insurance premium reduction	3
Grouping D	Simplifies the process of getting money from the insurer should an accident occur; or makes it easier to get a coverage	2
Grouping E	Is requested by the insurance company	1
Grouping F	There is no specific requirement	1
Grouping G	Does not imply in insurance premium reduction; but may be recommended	2
Grouping H	Answer does not match the subject asked	1
Grouping I	Blank	22
Total of answered questions		**35**

[Back to Question]

D 1.4.3 Check-Box

Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	**1**	1	0	0	0
New Zealand	**2**	1	0	1	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	1	1	1	0
Sweden	**4**	2	1	1	0
Norway	**1**	0	0	1	0
Canada	**3**	0	3	0	0
China	**1**	0	1	0	0
Spain	**1**	1	0	0	0
Russia	**1**	0	0	1	0

Japan	**3**	0	2	1	0
Germany	**1**	0	1	0	0
Brazil	**7**	5	2	0	0
United States	**1**	0	0	1	0
Mexico	**2**	2	0	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**13**	**11**	**7**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0
Macedonia	**1**	0	0	1	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	2	0	0
Total Observer Members (4)	**4**	**0**	**3**	**1**	**1**
Total Sum (20)	**35**	**13**	**14**	**8**	**3**

[Back to Question]

D 1.4.3 Open question

Question	Company	Answer	Coding
Please comment if applicable:	EMP005 (Switzerland)	Blank	E
	EMP006 (Switzerland)	Blank	E
	EMP008 (Brazil)	the joint work, was carried through in order to reduce the costs of the insurance using level risks parameters	A
	EMP009 (Japan)	Blank	E
	EMP010 (Canada)	Blank	E
	EMP012 (Mexico)	Se hacen inspecciones periódicas entre ambas partes	D
	EMP013 (Brazil)	Este posicionamneto é consensado dentro da empresa. As argumentações da CEMIG sempre foram preponderantes nas negociações de valores e níveis de risco em apólices.	A
	EMP015 (New Zealand)	Blank	E
	EMP016 (Brazil)	Usually, there is no cost reduction related to the use of fire protection systems.	C
	EMP019 (Sweden)	There is today no connection between fire protection and insurance cost	C
	EMP020 (Brazil)	Blank	E
	EMP021 (China)	Blank	E
	EMP023 (Spain)	Blank	E
	EMP025 (Brazil)	There is a joint work, but the cost reduction is estimated because Itaipu contracts insurances by a public licitation.	A
	EMP026 (Sweden)	Blank	E
	EMP027 (Macedonia)	Blank	E
	EMP028 (Japan)	Blank	E
	EMP031 (Mexico)	se hace limpieza de ductos y de aslamientos de manera periodica y a su vez se realizan inspecciones trimestrales.	D
	EMP032 (Canada)	Blank	E
	EMP033 (New Zealand)	Blank	E
	EMP036 (Canada)	Blank	E
	EMP037 (Russia)	Blank	E
	EMP038 (Sweden)	Blank	E
	EMP039 (Australia)	but no direct reduction in insurance premiums to justify fire protection	C
	EMP040 (Norway)	Blank	E
	EMP043 (Japan)	Blank	E
	EMP045 (Brazil)	The fire protection methods are designed by the technical group of the company (Brazil).	B
	EMP047 (Sweden)	Blank	E
	EMP048 (Germany)	Blank	E

	EMP051 (Austria)	Blank	E
	EMP053 (Poland)	Blank	E
	EMP054 (Austria)	Blank	E
	EMP055 (United States)	Blank	E
	EMP056 (Switzerland)	the shut-down periode is shorter	D
	EMP058 (Brazil)	Blank	E

Summary

Grouping	Legend	Quantity
Grouping A	Confirmed the cooperation work aiming price reduction	3
Grouping B	Confirmed that there is NO cooperation work aiming price reduction	1
Grouping C	Answer shows a misunderstanding of the question	3
Grouping D	Answer does not match the subject asked	3
Grouping E	Blank	25
Total of answered questions		**35**

[Back to Question]

D 1.5 Check-Box

1.5) Did you have fire in any of your generators in not least than the last 20 years?					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	1	0	0	0
New Zealand	**2**	2	0	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	0	3	0	0
Sweden	**4**	1	2	1	0
Norway	**1**	0	1	0	0
Canada	**3**	3	0	0	0
China	**1**	1	0	0	0
Spain	**1**	0	1	0	0
Russia	**1**	1	0	0	0
Japan	**3**	0	3	0	0
Germany	**1**	1	0	0	0
Brazil	**7**	4	3	0	0
United States	**1**	1	0	0	0
Mexico	**2**	2	0	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**17**	**13**	**1**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	1	0	0	0
Macedonia	**1**	1	0	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	1	1	0	0
Total Observer Members (4)	**4**	**3**	**1**	**0**	**1**
Total Sum (20)	**35**	**20**	**14**	**1**	**3**

[Back to Question]

D 1.5 Open question

Question	Company	Result			
		Answer	Answ.	Units	Note
1.5) Did you have fire in any of your	EMP005 (Switzerland)		0		
	EMP006 (Switzerland)		0		

generators in not least than the last 20 years? **If yes, how many?**	EMP008 (Brazil)		0		
	EMP009 (Japan)		0		
	EMP010 (Canada)	One.	1	1	
	EMP012 (Mexico)	5	1	5	
	EMP013 (Brazil)		0		
	EMP015 (New Zealand)	Two within the last 8 years in stations I am now responsible for, making a total of six cases that I have been involved with	1	6	Quantity corrected
	EMP016 (Brazil)		0		
	EMP019 (Sweden)	1 generator. Our Powerformer was totaly destroyd	1	1	
	EMP020 (Brazil)	5 fire accidents in the last 20 years: - Usina de Mascarenhas de Moraes:1995 (UG8) e 2003 (UG3); - Usina de L. C. Barreto de Carvalho (Estreito): 1991 (UG1); - Usina de Manso: 2004 (UG4). In all the cases the reason was the same, better said, short circuit between coils.	1	5	
	EMP021 (China)	Only one generator	1	1	
	EMP023 (Spain)		0		
	EMP025 (Brazil)	1	1	1	
	EMP026 (Sweden)		0		
	EMP027 (Macedonia)	Please see the attachmed table with more details. Note: that fire protection was designed to start by relay protection if internal fault in the generator occurred. This design has only two times activated fire protection for 50 years of operation of nine units due to internal fault in the generator. More than 7 times fire protection was activated by relay protection due to wrong operation of relay protection and some disturbances and short circuit in the HV grid outside of the generators. The real fire in the generators never happened. It is internal fault by short circuit in the windings and stopped by relay protection.	1	5	Quantity corrected
	EMP028 (Japan)		0		
	EMP031 (Mexico)	8	1	8	
	EMP032 (Canada)	>10 Due to time restraints I can only provide you with the name of the sites and number of machines where we experienced generator fires over the past 20 years. The exact date, machine number, outage cost and extent of damage and etc. will require additional time. To the best of my memory here is the detail: a) Four generator fires at our Long Spruce Generating station (Blister Pack failures and insulation break down under extreme temperatures- early 1980's) b) Six fires at Kettle Rapids Generating station (Generator end windings and circuit ring bus-1970's, 1980's 1990's & 2006) c) Great Falls generating station (generator disconnect operation under load propagating fire inside the generator housing - Human error- Late 1980's) d) Grand Rapids generating station (Head Cover failure leading to stator/rotor contact and ensuing fire-1992).	1	12	
	EMP033 (New Zealand)	2	1	2	
	EMP036 (Canada)	5 - more data was indicated using the corresppponding form for multiple machines	1	5	
	EMP037 (Russia)		1	**1**	Quantity corrected
	EMP038 (Sweden)		0		

	EMP039 (Australia)	One	1	1	
	EMP040 (Norway)		0		
	EMP043 (Japan)		0		
	EMP045 (Brazil)	They occurred CO2 discharges twice in our generators during this time and they were considered very preventives.	1	2	
	EMP047 (Sweden)		0		
	EMP048 (Germany)	Only once	1	1	
	EMP051 (Austria)		0		
	EMP053 (Poland)	But in very limited area due to stator winding short circuit.	1	2	Quantity corrected
	EMP054 (Austria)	1	1	1	
	EMP055 (EUA)	Two	1	2	
	EMP056 (Switzerland)		0		
	EMP058 (Brazil)	two generators	1	2	
			>	64	units

[Back to Question]

D 1.5.1 Check-Box

1.5.1) Did they occur on the same type of generator?					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	0	0	1	0
New Zealand	**2**	1	1	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	0	0	3	0
Sweden	**4**	0	1	3	0
Norway	**1**	0	0	1	0
Canada	**3**	2	1	0	0
China	**1**	0	1	0	0
Spain	**1**	0	0	1	0
Russia	**1**	0	1	0	0
Japan	**3**	0	1	2	0
Germany	**1**	0	0	1	0
Brazil	**7**	1	2	4	0
United States	**1**	1	0	0	0
Mexico	**2**	1	1	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**6**	**9**	**16**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0
Macedonia	**1**	0	1	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	0	2	0
Total Observer Members (4)	**4**	**0**	**2**	**2**	**1**
Total Sum (20)	**35**	**6**	**11**	**18**	**3**

[Back to Question]

D 1.5.1 Open question

Question	Company	Answer	Coding
1.5) Did you have fire in any of your generators in not least than the last 20 years?	EMP005 (Switzerland)	Blank	G
	EMP006 (Switzerland)	Blank	G
	EMP008 (Brazil)	Blank	G

If yes, how many?	EMP009 (Japan)	Blank	G
	EMP010 (Canada)	One.	A
	EMP012 (Mexico)	5	C
	EMP013 (Brazil)	Blank	G
	EMP015 (New Zealand)	Two within the last 8 years in stations I am now responsible for, making a total of six cases that I have been involved with	D
	EMP016 (Brazil)	Blank	G
	EMP019 (Sweden)	1 generator. Our Powerformer was totally destroyed	A
	EMP020 (Brazil)	5 fire accidents in the last 20 years: - Usina de Mascarenhas de Moraes:1995 (UG8) e 2003 (UG3); - Usina de L. C. Barreto de Carvalho (Estreito): 1991 (UG1); - Usina de Manso: 2004 (UG4). In all the cases the reason was the same, better said, short circuit between coils.	C
	EMP021 (China)	Only one generator	A
	EMP023 (Spain)	Blank	G
	EMP025 (Brazil)	1	A
	EMP026 (Sweden)	Blank	G
	EMP027 (Macedonia)	Please see the attachment table with more details. Note: that fire protection was designed to start by relay protection if internal fault in the generator occurred. This design has only two times activated fire protection for 50 years of operation of nine units due to internal fault in the generator. More than 7 times fire protection was activated by relay protection due to wrong operation of relay protection and some disturbances and short circuit in the HV grid outside of the generators. The real fire in the generators never happened. It is internal fault by short circuit in the windings and stopped by relay protection.	C
	EMP028 (Japan)	Blank	G
	EMP031 (Mexico)	8	E
	EMP032 (Canada)	>10 Due to time restraints I can only provide you with the name of the sites and number of machines where we experienced generator fires over the past 20 years. The exact date, machine number, outage cost and extent of damage and etc. will require additional time. To the best of my memory here is the detail: a) Four generator fires at our Long Spruce Generating station (Blister Pack failures and insulation break down under extreme temperatures-early 1980's) b) Six fires at Kettle Rapids Generating station (Generator end windings and circuit ring bus-1970's, 1980's 1990's & 2006) c) Great Falls generating station (generator disconnect operation under load propagating fire inside the generator housing - Human error- Late 1980's) d) Grand Rapids generating station (Head Cover failure leading to stator/rotor contact and ensuing fire-1992).	F
	EMP033 (New Zealand)	2	B
	EMP036 (Canada)	5 - more data was indicated using the corresponding form for multiple machines	C
	EMP037 (Russia)	Blank	A
	EMP038 (Sweden)	Blank	G
	EMP039 (Australia)	One	A
	EMP040 (Norway)	Blank	G
	EMP043 (Japan)	Blank	G
	EMP045 (Brazil)	They occurred CO2 discharges twice in our generators during this time and they were considered very preventives.	B
	EMP047 (Sweden)	Blank	G
	EMP048 (Germany)	Only once	A
	EMP051 (Austria)	Blank	G
	EMP053 (Poland)	But in very limited area due to stator winding short circuit.	B
	EMP054 (Austria)	1	A
	EMP055 (United States)	Two	B
	EMP056 (Switzerland)	Blank	G

	EMP058 (Brazil)	two generators	B

Summary

Grouping	Legend	Quantity
Grouping A	1 Unit	8
Grouping B	2 Units	5
Grouping C	5 Units	4
Grouping D	6 Units	1
Grouping E	8 Units	1
Grouping F	12 Units	1
Grouping G	Blank	15
Total of answered questions		**35**

[Back to Question]

D 1.5.1.1 Consolidated

1.5.1.1) What was the reason for the fire to start?

Company	Data for	Year of the accident	Count of the considered examples	1.5.1.1.1) Electrical Fault in the stator winding	1.5.1.1.2) Electrical fault in the rotor winding	1.5.1.1.3) Electrical fault in the exciter housing	1.5.1.1.4) Mechanical Fault in bearings	1.5.1.1.5) Other Mechanical faults	1.5.1.1.6) Any other?
EMP005 (Switzerland)			0						
EMP006 (Switzerland)			0						
EMP008 (Brazil)			0						
EMP009 (Japan)			0						
EMP010 (Canada)	Gen-01		1	1					
EMP012 (Mexico)	Gen-01		1	1					
	Gen-02		1	1					
	Gen-03		1	1					
	Gen-04		1				1		
	Gen-05		1		1				
EMP013 (Brazil)			0						
EMP015 (New Zealand)	Gen-01	2000	1	1					
	Gen-02	1998	1	1					
	Gen-03	1995	1	1					
	Gen-04	1994	1	1					
	Gen-05	1984	1	1					
	Gen-06		1	1					
EMP016 (Brazil)			0						
EMP019 (Sweden)	Gen-01		1	1					
EMP020 (Brazil)	Gen-01		1	1					
	Gen-02		1	1					
	Gen-03		1	1					
	Gen-04		1	1					
	Gen-05		1	1					
EMP021 (China)	Gen-01		1	1					
EMP023 (Spain)			0						

EMP025 (Brazil)	Gen-01		1	1					
EMP026 (Sweden)			0						
EMP027 (Macedonia)	Gen-01		1	1					
	Gen-02		1	1					
	Gen-03		1	1					
	Gen-04		1				1		
	Gen-05		1		1				
EMP028 (Japan)			0						
EMP031 (Mexico)	Gen-01		1	1					
	Gen-02		1		1				
	Gen-03		1		1				
	Gen-04		1				1		
	Gen-05		1					1	
	Gen-06		1	1					
	Gen-07		1		1				
	Gen-08		1				1		
EMP032 (Canada)	Gen-01	1980	1						1
	Gen-02	1980	1						1
	Gen-03	1980	1						1
	Gen-04	1980	1						1
	Gen-05	1970	1	1					
	Gen-06	1970	1	1					
	Gen-07	1980	1	1					
	Gen-08	1980	1	1					
	Gen-09	1990	1	1					
	Gen-10	1990	1	1					
	Gen-11	1980	1						1
	Gen-12	1992	1						1
EMP033 (New Zealand)	Gen-01	1995	1	1					
	Gen-02	1996	1					1	
EMP036 (Canada)	Gen-01	2006	1	1					
	Gen-02		1	1					
	Gen-03		1	1					
	Gen-04		1			1			
	Gen-05		1		1				
EMP037 (Russia)	Gen-01		1	1					
EMP038 (Sweden)			0						
EMP039 (Australia)	Gen-01		1			1			
EMP040 (Norway)			0						
EMP043 (Japan)			0						
EMP045 (Brazil)	Gen-01	2001	1	1					
	Gen-02		1					1	
EMP047 (Sweden)			0						
EMP048 (Germany)	Gen-01		1					1	
EMP051 (Austria)			0						
EMP053 (Poland)	Gen-01		1	1					
	Gen-02		1		1				
EMP054 (Austria)	Gen-01		1	1					
EMP055 (United States)	Gen-01	2003	1	1					
	Gen-02	1980	1	1					
EMP056 (Switzerland)			0						
EMP058 (Brazil)	Gen-01		1		1				
	Gen-02		1				1		
Statistics			**64**	**39**	**8**	**2**	**5**	**4**	**6**

[Back to Question]

D 1.5.1.1.1 Check-Box

Regular Members	Answers	Yes	N. Answ
Australia	**1**	0	0
New Zealand	**2**	7	0
United Kingdom	**0**	0	1
Switzerland	**3**	0	0
Sweden	**4**	1	0
Norway	**1**	0	0
Canada	**3**	10	0
China	**1**	1	0
Spain	**1**	0	0
Russia	**1**	1	0
Japan	**3**	0	0
Germany	**1**	0	0
Brazil	**7**	7	0
United States	**1**	2	0
Mexico	**2**	5	0
France	**0**	0	1
Total Regular Members (16)	**31**	34	**2**
Observer Members	**Answers**	**Yes**	**N. Answ**
Poland	**1**	1	0
Macedonia	**1**	3	0
Belgium	**0**	0	1
Austria	**2**	1	0
Total Observer Members (4)	**4**	5	**1**
Total Sum (20)	**35**	39	**3**

NOTE 1: the alternatives **NO** and **Blank** do not apply in this case.
NOTE 2: this table already considers the answers of the "form for multiple machines".

[Back to Question]

D 1.5.1.1.1 Open question

Question	Company	Data for	Units	Answer	Grouping
1.5.1.1.1) Electrical Fault in the stator winding Additional information:	EMP005 (Switzerland)				
	EMP006 (Switzerland)				
	EMP008 (Brazil)				
	EMP009 (Japan)				
	EMP010 (Canada)	Gen-01	1	Brake Clamp came loose and hit the stator winding resulting in a phase to ground fault.	B
	EMP012 (Mexico)	Gen-01	1	Failure on the bearing cooling system, causing the stator to be wet which caused a fault between phases.	A
		Gen-02	1	Not indicated	F
		Gen-03	1	Not indicated	F
		Gen-04			
		Gen-05			

	EMP013 (Brazil)				
	EMP015 (New Zealand)	Gen-01	1	Fire has been the results of defects that have developed into phase to phase faults (lot of energy able to be feed into fault). Never seen a fire result from a straight earth fault.	A
		Gen-02	1	Not indicated	F
		Gen-03	1	Not indicated	F
		Gen-04	1	Not indicated	F
		Gen-05	1	Not indicated	F
		Gen-06	1	Not indicated	F
	EMP016 (Brazil)				
	EMP019 (Sweden)	Gen-01	1	Probably one or two earth faults.	B
	EMP020 (Brazil)	Gen-01	1	Reason was short circuit between coils.	A
		Gen-02	1	Not indicated	F
		Gen-03	1	Not indicated	F
		Gen-04	1	Not indicated	F
		Gen-05	1	Not indicated	F
	EMP021 (China)	Gen-01	1	Not indicated	F
	EMP023 (Spain)				
	EMP025 (Brazil)	Gen-01	1	Damage on a lower statos bars welding with consequent arc over the direct cooling tubing.	E
	EMP026 (Sweden)				
	EMP027 (Macedonia)	Gen-01	1	The real fire in the generators never happened. It is internal fault by short circuit in the windings and stopped by relay protection.	A
		Gen-02	1	Not indicated	F
		Gen-03	1	Not indicated	F
		Gen-04			
		Gen-05			
	EMP028 (Japan)				
	EMP031 (Mexico)	Gen-01	1	Ground to earth due to insulation fault	B
		Gen-02			
		Gen-03			
		Gen-04			
		Gen-05			
		Gen-06	1	Not indicated	F
		Gen-07			
		Gen-08			
	EMP032 (Canada)	Gen-01			
		Gen-02			
		Gen-03			
		Gen-04			
		Gen-05	1	Generator end windings and circuit ring bus	A
		Gen-06	1	Not Indicated	F
		Gen-07	1	Not Indicated	F
		Gen-08	1	Not Indicated	F

		Gen-09	1	Not Indicated	F
		Gen-10	1	Not Indicated	F
		Gen-11			
		Gen-12			
	EMP033 (New Zealand)	Gen-01	1	Not indicated	F
		Gen-02			
	EMP036 (Canada)	Gen-01	1	Not indicated	F
		Gen-02	1	Not indicated	F
		Gen-03	1	Not indicated	F
		Gen-04			
		Gen-05			
	EMP037 (Russia)	Gen-01	1	Breakdown of isolation and short circuit	C
	EMP038 (Sweden)				
	EMP039 (Australia)	Gen-01			
	EMP040 (Norway)				
	EMP043 (Japan)				
	EMP045 (Brazil)	Gen-01	1	Short circuit between phases of generator.	A
		Gen-02			
	EMP047 (Sweden)				
	EMP048 (Germany)	Gen-01			
	EMP051 (Austria)				
	EMP053 (Poland)	Gen-01	1	Burnt flexible connection in stator winding	D
		Gen-02			
	EMP054 (Austria)	Gen-01	1	Failure in soft soldered joint	E
	EMP055 (United States)	Gen-01	1	Not indicated	F
		Gen-02	1	Not indicated	F
	EMP056 (Switzerland)				
	EMP058 (Brazil)	Gen-01			
		Gen-02			

[Back to Question]

D 1.5.1.1.2 Check-Box

1.5.1.1.2) Electrical fault in the rotor winding			
Regular Members	**Answers**	**Yes**	**N. Answ**
Australia	**1**	0	0
New Zealand	**2**	0	0
United Kingdom	**0**	0	1
Switzerland	**3**	0	0
Sweden	**4**	0	0
Norway	**1**	0	0
Canada	**3**	1	0
China	**1**	0	0
Spain	**1**	0	0
Russia	**1**	0	0
Japan	**3**	0	0
Germany	**1**	0	0

Brazil	**7**	1	0
United States	**1**	0	0
Mexico	**2**	4	0
France	**0**	0	1
Total Regular Members (16)	**31**	6	**2**
Observer Members	**Answers**		**N. Answ**
Poland	**1**	1	0
Macedonia	**1**	1	0
Belgium	**0**	0	1
Austria	**2**	0	0
Total Observer Members (4)	**4**	2	**1**
Total Sum (20)	**35**	8	**3**

NOTE 1: the alternatives **NO** and **Blank** do not apply in this case.
NOTE 2: this table already considers the answers of the "form for multiple machines".

[Back to Question]

D 1.5.1.1.2 Open question

Question	Company	Data for	Units	Answer
1.5.1.1.2) Electrical fault in the rotor winding Additional information:	EMP005 (Switzerland)			
	EMP006 (Switzerland)			
	EMP008 (Brazil)			Not applicable
	EMP009 (Japan)			
	EMP010 (Canada)	Gen-01		
	EMP012 (Mexico)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05	1	Not indicated
	EMP013 (Brazil)			
	EMP015 (New Zealand)	Gen-01		Have seen a pole to pole connection vaporize and while there was considerable arc splatter there was no fire
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
		Gen-06		
	EMP016 (Brazil)			
	EMP019 (Sweden)	Gen-01		
	EMP020 (Brazil)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
	EMP021 (China)	Gen-01		
	EMP023 (Spain)			
	EMP025 (Brazil)	Gen-01		

	EMP026 (Sweden)			
	EMP027 (Macedonia)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05	1	Not indicated
	EMP028 (Japan)			
	EMP031 (Mexico)	Gen-01		
		Gen-02	1	Because a pole to pole connection got loose
		Gen-03	1	Not indicated
		Gen-04		
		Gen-05		
		Gen-06		
		Gen-07	1	Not indicated
		Gen-08		
	EMP032 (Canada)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
		Gen-06		
		Gen-07		
		Gen-08		
		Gen-09		
		Gen-10		
		Gen-11		
		Gen-12		
	EMP033 (New Zealand)	Gen-01		
		Gen-02		
	EMP036 (Canada)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05	1	Not indicated
	EMP037 (Russia)	Gen-01		
	EMP038 (Sweden)			
	EMP039 (Australia)	Gen-01		
	EMP040 (Norway)			
	EMP043 (Japan)			
	EMP045 (Brazil)	Gen-01		
		Gen-02		
	EMP047 (Sweden)			
	EMP048 (Germany)	Gen-01		
	EMP051 (Austria)			
	EMP053 (Poland)	Gen-01		
		Gen-02	1	Burnt flexible connection
	EMP054 (Austria)	Gen-01		
	EMP055 (United States)	Gen-01		
		Gen-02		
	EMP056 (Switzerland)			

	EMP058 (Brazil)	Gen-01	1	There was circuit breaker failure after several relays operations and the 32 MVA machine operated like synchronous motor and in sequence how asynchronous generator during long time.
		Gen-02		Not indicated

[Back to Question]

D 1.5.1.1.3 Check-Box

1.5.1.1.3) Electrical fault in the exciter housing			
Regular Members	**Answers**	**Yes**	**N. Answ**
Australia	**1**	1	0
New Zealand	**2**	0	0
United Kingdom	**0**	0	1
Switzerland	**3**	0	0
Sweden	**4**	0	0
Norway	**1**	0	0
Canada	**3**	1	0
China	**1**	0	0
Spain	**1**	0	0
Russia	**1**	0	0
Japan	**3**	0	0
Germany	**1**	0	0
Brazil	**7**	0	0
United States	**1**	0	0
Mexico	**2**	0	0
France	**0**	0	1
Total Regular Members (16)	**31**	2	**2**
Observer Members	**Answers**	Yes	**N. Answ**
Poland	**1**	0	0
Macedonia	**1**	0	0
Belgium	**0**	0	1
Austria	**2**	0	0
Total Observer Members (4)	**4**	0	**1**
Total Sum (20)	**35**	2	**3**

NOTE 1: the alternatives **NO** and **Blank** do not apply in this case.
NOTE 2: this table already considers the answers of the "form for multiple machines".

[Back to Question]

D 1.5.1.1.3 Open question

Question	Company	Data for	Units	Answer
1.5.1.1.3) Electrical fault in the exciter housing Additional information:	EMP005 (Switzerland)			
	EMP006 (Switzerland)			
	EMP008 (Brazil)			Not applicable

	EMP009 (Japan)			
	EMP010 (Canada)	Gen-01		
	EMP012 (Mexico)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
	EMP013 (Brazil)			
	EMP015 (New Zealand)	Gen-01		Have seen a couple of slip ring catherine wheels (the traditional name for a spinning firework) as the result of carbon brush failures but no fire as the result.
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
		Gen-06		
	EMP016 (Brazil)			
	EMP019 (Sweden)	Gen-01		
	EMP020 (Brazil)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
	EMP021 (China)	Gen-01		
	EMP023 (Spain)			
	EMP025 (Brazil)	Gen-01		
	EMP026 (Sweden)			
	EMP027 (Macedonia)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		Not indicated
		Gen-05		
	EMP028 (Japan)			
	EMP031 (Mexico)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
		Gen-06		
		Gen-07		
		Gen-08		
	EMP032 (Canada)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
		Gen-06		
		Gen-07		
		Gen-08		
		Gen-09		
		Gen-10		
		Gen-11		

		Gen-12		
	EMP033 (New Zealand)	Gen-01		Excitation connections to the generator failed causing the leads to "flap" free and shear off a large proportion of the end windings resulting in a generator fire.
		Gen-02		
	EMP036 (Canada)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04	1	Not indicated
		Gen-05		
	EMP037 (Russia)	Gen-01		
	EMP038 (Sweden)			
	EMP039 (Australia)	Gen-01	1	Unit had CO2 generator fire suppression which did not cover the exciter housing directly. CO2 was not released and when fault was cleared fire went out.
	EMP040 (Norway)			
	EMP043 (Japan)			
	EMP045 (Brazil)	Gen-01		
		Gen-02		
	EMP047 (Sweden)			
	EMP048 (Germany)	Gen-01		
	EMP051 (Austria)			
	EMP053 (Poland)	Gen-01		
		Gen-02		
	EMP054 (Austria)	Gen-01		
	EMP055 (United States)	Gen-01		
		Gen-02		
	EMP056 (Switzerland)			
	EMP058 (Brazil)	Gen-01		The failure of the exciter system was consequence of the main circuit breaker failure registered above.
		Gen-02		

[Back to Question]

D 1.5.1.1.4 Check-Box

1.5.1.1.4) Mechanical Fault in bearings

Regular Members	Answers	Yes	N. Answ
Australia	**1**	0	0
New Zealand	**2**	0	0
United Kingdom	**0**	0	1
Switzerland	**3**	0	0
Sweden	**4**	0	0
Norway	**1**	0	0
Canada	**3**	0	0
China	**1**	0	0
Spain	**1**	0	0
Russia	**1**	0	0

Japan	**3**	0	0
Germany	**1**	0	0
Brazil	**7**	1	0
United States	**1**	0	0
Mexico	**2**	4	0
France	**0**	0	1
Total Regular Members (16)	**31**	5	**2**
Observer Members	**Answers**	Yes	**N. Answ**
Poland	**1**	0	0
Macedonia	**1**	0	0
Belgium	**0**	0	1
Austria	**2**	0	0
Total Observer Members (4)	**4**	0	**1**
Total Geral (20)	**35**	5	**3**

NOTE 1: the alternatives **NO** and **Blank** do not apply in this case.
NOTE 2: this table already considers the answers of the "form for multiple machines".

[Back to Question]

D 1.5.1.1.4 Open question

Question	Company	Data for	Units	Answer
1.5.1.1.4) Mechanical Fault in bearings Additional information:	EMP005 (Switzerland)			
	EMP006 (Switzerland)			
	EMP008 (Brazil)			Not applicable
	EMP009 (Japan)			
	EMP010 (Canada)	Gen-01		
	EMP012 (Mexico)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04	1	Failure on the bearing cooling system, causing the stator to be wet which caused a fault between phases.
		Gen-05		
	EMP013 (Brazil)			
	EMP015 (New Zealand)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
		Gen-06		
	EMP016 (Brazil)			
	EMP019 (Sweden)	Gen-01		
	EMP020 (Brazil)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
	EMP021 (China)	Gen-01		
	EMP023			

	(Spain)			
	EMP025 (Brazil)	Gen-01		
	EMP026 (Sweden)			
	EMP027 (Macedonia)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04	1	Not indicated
		Gen-05		
	EMP028 (Japan)			
	EMP031 (Mexico)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04	1	Lack of lubrication and high temperatures
		Gen-05		
		Gen-06		
		Gen-07		
		Gen-08	1	Not indicated
	EMP032 (Canada)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
		Gen-06		
		Gen-07		
		Gen-08		
		Gen-09		
		Gen-10		
		Gen-11		
		Gen-12		
	EMP033 (New Zealand)	Gen-01		
		Gen-02		
	EMP036 (Canada)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
	EMP037 (Russia)	Gen-01		
	EMP038 (Sweden)			
	EMP039 (Australia)	Gen-01		
	EMP040 (Norway)			
	EMP043 (Japan)			
	EMP045 (Brazil)	Gen-01		
		Gen-02		
	EMP047 (Sweden)			
	EMP048 (Germany)	Gen-01		
	EMP051 (Austria)			
	EMP053 (Poland)	Gen-01		
		Gen-02		
	EMP054 (Austria)	Gen-01		
	EMP055 (United States)	Gen-01		
		Gen-02		
	EMP056			

	(Switzerland)			
	EMP058 (Brazil)	Gen-01		
		Gen-02	1	All those damages has began after oil circulation failure of the turbine thrust bearing. The main circuit breaker haven't opened after relay's high temperature metal operation.

[Back to Question]

D 1.5.1.1.5 Check-Box

1.5.1.1.5) Other Mechanical faults			
Regular Members	**Answers**	**Yes**	**N. Answ**
Australia	**1**	0	0
New Zealand	**2**	1	0
United Kingdom	**0**	0	1
Switzerland	**3**	0	0
Sweden	**4**	0	0
Norway	**1**	0	0
Canada	**3**	0	0
China	**1**	0	0
Spain	**1**	0	0
Russia	**1**	0	0
Japan	**3**	0	0
Germany	**1**	1	0
Brazil	**7**	1	0
United States	**1**	0	0
Mexico	**2**	1	0
France	**0**	0	1
Total Regular Members (16)	**31**	4	**2**
Observer Members	**Answers**	**Yes**	**N. Answ**
Poland	**1**	0	0
Macedonia	**1**	0	0
Belgium	**0**	0	1
Austria	**2**	0	0
Total Observer Members (4)	**4**	0	**1**
Total Sum (20)	**35**	4	**3**

NOTE 1: the alternatives **NO** and **Blank** do not apply in this case.
NOTE 2: this table already considers the answers of the "form for multiple machines".

[Back to Question]

D 1.5.1.1.5 Open question

Question	Company	Data for	Units	Answer
1.5.1.1.5) Other Mechanical faults Additional information:	EMP005 (Switzerland)			
	EMP006 (Switzerland)			
	EMP008 (Brazil)			Not applicable
	EMP009 (Japan)			

	EMP010 (Canada)	Gen-01		
	EMP012 (Mexico)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
	EMP013 (Brazil)			
	EMP015 (New Zealand)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
		Gen-06		
	EMP016 (Brazil)			
	EMP019 (Sweden)	Gen-01		
	EMP020 (Brazil)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
	EMP021 (China)	Gen-01		
	EMP023 (Spain)			
	EMP025 (Brazil)	Gen-01		
	EMP026 (Sweden)			
	EMP027 (Macedonia)	Gen-01		Generator 1: the insulation part of rotor pole was broken
		Gen-02		Generator 2: Mechanical part of bolt from lubrication system was broken and fall inside the generator during the testing of generator for start up after rehabilitation of lubrication system
		Gen-03		
		Gen-04		
		Gen-05		
	EMP028 (Japan)			
	EMP031 (Mexico)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05	1	Faults in Servo-motors, Speed regulators and Bearings
		Gen-06		
		Gen-07		
		Gen-08		
	EMP032 (Canada)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
		Gen-06		
		Gen-07		
		Gen-08		
		Gen-09		
		Gen-10		
		Gen-11		

		Gen-12		
	EMP033 (New Zealand)	Gen-01		
		Gen-02	1	An item of steel was left behind in the generator enclosure following routine maintenance. The item caused an electrical fault in the stator, resulting in a generator fire.
	EMP036 (Canada)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
	EMP037 (Russia)	Gen-01		
	EMP038 (Sweden)			
	EMP039 (Australia)	Gen-01		
	EMP040 (Norway)			
	EMP043 (Japan)			
	EMP045 (Brazil)	Gen-01		
		Gen-02	1	Smoke detectors had detected smoke indications originated from the rubbing between the fixed and mobile air guides, being the fixed air guide manufactured of isolating material and the mobile of metallic material.
	EMP047 (Sweden)			
	EMP048 (Germany)	Gen-01	1	Leakage in the lubrication system. Oil intrusion in the slip ring.
	EMP051 (Austria)			
	EMP053 (Poland)	Gen-01		Broken mechanical parts
		Gen-02		
	EMP054 (Austria)	Gen-01		
	EMP055 (United States)	Gen-01		
		Gen-02		
	EMP056 (Switzerland)			
	EMP058 (Brazil)	Gen-01		
		Gen-02		

[Back to Question]

D 1.5.1.1.6 Check-Box

1.5.1.1.6) Any other?			
Regular Members	**Answers**	**Yes**	**N. Answ**
Australia	**1**	0	0
New Zealand	**2**	0	0
United Kingdom	**0**	0	1
Switzerland	**3**	0	0
Sweden	**4**	0	0
Norway	**1**	0	0
Canada	**3**	6	0
China	**1**	0	0
Spain	**1**	0	0
Russia	**1**	0	0
Japan	**3**	0	0

Germany	**1**	0	0
Brazil	**7**	0	0
United States	**1**	0	0
Mexico	**2**	0	0
France	**0**	0	1
Total Regular Members (16)	**31**	6	**2**
Observer Members	**Answers**	**Yes**	**N. Answ**
Poland	**1**	0	0
Macedonia	**1**	0	0
Belgium	**0**	0	1
Austria	**2**	0	0
Total Observer Members (4)	**4**	0	**1**
Total Sum (20)	**35**	6	**3**

NOTE 1: the alternatives **NO** and **Blank** do not apply in this case.
NOTE 2: this table already considers the answers of the "form for multiple machines".

[Back to Question]

D 1.5.1.1.6 Open question

Question	Company	Data for	Units	Answer
1.5.1.1.6) Any other? Additional information:	EMP005 (Switzerland)			
	EMP006 (Switzerland)			
	EMP008 (Brazil)			Not applicable
	EMP009 (Japan)			
	EMP010 (Canada)	Gen-01		
	EMP012 (Mexico)	Gen-01		A machine circuit breaker failure caused circulating currents in the rotor, the temperature rose and set fire to the cover plates of fiberglass for air deflection causing a fire.
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
	EMP013 (Brazil)			
	EMP015 (New Zealand)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
		Gen-06		
	EMP016 (Brazil)			
	EMP019 (Sweden)	Gen-01		
	EMP020 (Brazil)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		

	EMP021 (China)	Gen-01		
	EMP023 (Spain)			
	EMP025 (Brazil)	Gen-01		
	EMP026 (Sweden)			
	EMP027 (Macedonia)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
	EMP028 (Japan)			
	EMP031 (Mexico)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
		Gen-06		
		Gen-07		
		Gen-08		
	EMP032 (Canada)	Gen-01	1	Circuit ring bus fires, Upper windings blister packs failures, End windings faults
		Gen-02	1	Not indicated
		Gen-03	1	Not indicated
		Gen-04	1	Not indicated
		Gen-05		
		Gen-06		
		Gen-07		
		Gen-08		
		Gen-09		
		Gen-10		
		Gen-11	1	Generator disconnect operation under load propagating fire inside the generator housing
		Gen-12	1	Head Cover failure leading to stator/rotor contact and ensuing fire
	EMP033 (New Zealand)	Gen-01		
		Gen-02		
	EMP036 (Canada)	Gen-01		
		Gen-02		
		Gen-03		
		Gen-04		
		Gen-05		
	EMP037 (Russia)	Gen-01		
	EMP038 (Sweden)			
	EMP039 (Australia)	Gen-01		
	EMP040 (Norway)			
	EMP043 (Japan)			
	EMP045 (Brazil)	Gen-01		The attrition between electrically passive components of the rotor and the stator generated heat that evolved for fire (heat + smoke)
		Gen-02		
	EMP047 (Sweden)			
	EMP048 (Germany)	Gen-01		

	EMP051 (Austria)			
	EMP053 (Poland)	Gen-01		
		Gen-02		
	EMP054 (Austria)	Gen-01		
	EMP055 (United States)	Gen-01		
		Gen-02		
	EMP056 (Switzerland)			
	EMP058 (Brazil)	Gen-01		
		Gen-02		

[Back to Question]

D 1.5.2 Consolidated

Question	Company	Data for	Year of the accident	Count of the considered examples	1.5.2.1) Was the unit equipped with GFP?	1.5.2.2) Did the GFP work according to the design?	1.5.2.3) Was the fire extinguished by the installed GFP?	1.5.2.4) Did the fire spread outside the generator?	1.5.2.5) Give a brief description of the damage:	1.5.2.6) Were there any direct or indirect fatalities?	1.5.2.7) Was the GFP designed to trigger automatically?
1.5.2) Please provide the following information on the units where fires occurred in not least than the last twenty years.	EMP005 (Switzerland)			0							
	EMP006 (Switzerland)			0							
	EMP008 (Brazil)			0							
	EMP009 (Japan)			0							
	EMP010 (Canada)	Gen-01		1	1	1	1	0	1	0	1
	EMP012 (Mexico)	Gen-01		1	1	1	1	0	1	0	1
		Gen-02		1	-	-	-	-	-	-	-
		Gen-03		1	-	-	-	-	-	-	-
		Gen-04		1	-	-	-	-	-	-	-
		Gen-05		1	-	-	-	-	-	-	-
	EMP013 (Brazil)			0							
	EMP015 (New Zealand)	Gen-01	2000	1	1	0	1	0	1	0	1
		Gen-02	1998	1	1	0	1	0	1	0	1
		Gen-03	1995	1	1	0	1	0	1	0	1
		Gen-04	1994	1	1	0	1	0	1	0	1
		Gen-05	1984	1	1	0	1	0	1	0	1
		Gen-06		1	1	0	1	0	1	0	1
	EMP016 (Brazil)			0							
	EMP019 (Sweden)	Gen-01		1	0	0	0	0	0	1	0
	EMP020 (Brazil)	Gen-01		1	1	1	1	0	-	-	0
		Gen-02		1	-	-	-	-	-	-	-
		Gen-03		1	-	-	-	-	-	-	-

	Gen-04		1	-	-	-	-	-	-	-
	Gen-05		1	-	-	-	-	-	-	-
EMP021 (China)	Gen-01		1	1	0	1	0	1	0	1
EMP023 (Spain)			0							
EMP025 (Brazil)	Gen-01		1	1	1	1	0	0	0	1
EMP026 (Sweden)			0							
EMP027 (Macedonia)	Gen-01		1	1	1	1	0	1	0	1
	Gen-02		1	-	-	-	-	-	-	-
	Gen-03		1	-	-	-	-	-	-	-
	Gen-04		1	-	-	-	-	-	-	-
	Gen-05		1	-	-	-	-	-	-	-
EMP028 (Japan)			0							
EMP031 (Mexico)	Gen-01		1	1	1	1	0	1	0	1
	Gen-02		1	-	-	-	-	-	-	-
	Gen-03		1	-	-	-	-	-	-	-
	Gen-04		1	-	-	-	-	-	-	-
	Gen-05		1	-	-	-	-	-	-	-
	Gen-06		1	-	-	-	-	-	-	-
	Gen-07		1	-	-	-	-	-	-	-
	Gen-08		1	-	-	-	-	-	-	-
EMP032 (Canada)	Gen-01		1	1	1	1	0	1	0	1
	Gen-02		1	-	-	-	-	-	-	-
	Gen-03		1	-	-	-	-	-	-	-
	Gen-04		1	-	-	-	-	-	-	-
	Gen-05		1	-	-	-	-	-	-	-
	Gen-06		1	-	-	-	-	-	-	-
	Gen-07		1	-	-	-	-	-	-	-
	Gen-08		1	-	-	-	-	-	-	-
	Gen-09		1	-	-	-	-	-	-	-
	Gen-10		1	-	-	-	-	-	-	-
	Gen-11		1	-	-	-	-	-	-	-
	Gen-12		1	-	-	-	-	-	-	-
EMP033 (New Zealand)	Gen-01	1995	1	1	0	0	0	1	0	1
	Gen-02	1996	1	1	0	0	0	1	0	1
EMP036 (Canada)	Gen-01		1	1	1	1	0	1	0	1
	Gen-02		1	-	-	-	-	-	-	-
	Gen-03		1	-	-	-	-	-	-	-
	Gen-04		1	-	-	-	-	-	-	-
	Gen-05		1	-	-	-	-	-	-	-
EMP037 (Russia)	Gen-01		1	1	1	1	0	0	0	1
EMP038 (Sweden)			0							
EMP039 (Australia)	Gen-01		1	1	1	0	0	1	0	1
EMP040 (Norway)			0							
EMP043 (Japan)			0							
EMP045 (Brazil)	Gen-01	2001	1	1	1	1	0	0	0	-
	Gen-02		1	1	1	1	0	0	0	-
EMP047 (Sweden)			0							
EMP048 (Germany)	Gen-01		1	1	1	0	1	1	0	1
EMP051 (Austria)			0							
EMP053 (Poland)	Gen-01		1	1	1	1	0	1	0	0
	Gen-02		1	-	-	-	-	-	-	-
EMP054 (Austria)	Gen-01		1	0	-	-	0	1	0	0
EMP055 (United States)	Gen-01	2003	1	1	0	0	0	1	0	1
	Gen-02	1980	1	1	0	0	0	0	0	1
EMP056 (Switzerland)			0							
EMP058 (Brazil)	Gen-01		1	1	1	1	0	1	0	1
	Gen-02		1	-	-	-	-	-	-	-

Statistics	64	26	15	20	1	21	1	22
Yes		26	15	20	1		1	22
No		2	11	7	27		26	4

[Back to Question]

D 1.5.2.1 Check-Box

1.5.2.1) Was the unit equipped with fire protection equipment?

Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	**1**	1	0	0	0
New Zealand	**2**	8	0	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	0	0	3	0
Sweden	**4**	0	1	3	0
Norway	**1**	0	0	1	0
Canada	**3**	3	0	0	0
China	**1**	1	0	0	0
Spain	**1**	0	0	1	0
Russia	**1**	1	0	0	0
Japan	**3**	0	0	3	0
Germany	**1**	1	0	0	0
Brazil	**7**	5	0	3	0
United States	**1**	2	0	0	0
Mexico	**2**	2	0	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	24	1	**14**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	1	0	0	0
Macedonia	**1**	1	0	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	1	1	0
Total Observer Members (4)	**4**	2	1	**1**	**1**
Total Sum (20)	**35**	26	2	**15**	**3**

NOTE 1: this table already considers the answers of the "form for multiple machines".

[Back to Question]

D 1.5.2.1 Open question

1.5.2.1) Was the unit equipped with fire protection equipment?

Question	Company	Data for	Yes	Answer	Grouping
If Yes, what is the extinguishing media? (Eg. CO2, water, etc). If the media is chemical, please give the name.	EMP005 (Switzerland)				
	EMP006 (Switzerland)				
	EMP008 (Brazil)				
	EMP009 (Japan)				
	EMP010 (Canada)	Gen-01	1	Water	C
	EMP012 (Mexico)	Gen-01	1	CO2	A
		Gen-02	-	-	
		Gen-03	-	-	
		Gen-04	-	-	

	Gen-05	-	-	
EMP013 (Brazil)				
EMP015 (New Zealand)	Gen-01	1	CO2	A
	Gen-02	1	CO2	A
	Gen-03	1	CO2	A
	Gen-04	1	CO2	A
	Gen-05	1	CO2	A
	Gen-06	1	CO2	A
EMP016 (Brazil)				
EMP019 (Sweden)	Gen-01	0	NONE	D
EMP020 (Brazil)	Gen-01	1	-	
	Gen-02	-	-	
	Gen-03	-	-	
	Gen-04	-	-	
	Gen-05	-	-	
EMP021 (China)	Gen-01	1	Water	C
EMP023 (Spain)				
EMP025 (Brazil)	Gen-01	1	CO2	A
EMP026 (Sweden)				
EMP027 (Macedonia)	Gen-01	1	CO2	A
	Gen-02	-	-	
	Gen-03	-	-	
	Gen-04	-	-	
	Gen-05	-	-	
EMP028 (Japan)				
EMP031 (Mexico)	Gen-01	1	CO2 + Foam	B
	Gen-02	-	-	
	Gen-03	-	-	
	Gen-04	-	-	
	Gen-05	-	-	
	Gen-06	-	-	
	Gen-07	-	-	
	Gen-08	-	-	
EMP032 (Canada)	Gen-01	1	Water	C
	Gen-02	-		
	Gen-03	-		
	Gen-04	-		
	Gen-05	-		
	Gen-06	-		
	Gen-07	-		
	Gen-08	-		
	Gen-09	-		
	Gen-10	-		
	Gen-11	-		
	Gen-12	-		
EMP033 (New Zealand)	Gen-01	1	CO2	A
	Gen-02	1	CO2	A
EMP036 (Canada)	Gen-01	1	-	
	Gen-02	-		
	Gen-03	-		
	Gen-04	-		
	Gen-05	-		
EMP037 (Russia)	Gen-01	1	Water	C
EMP038 (Sweden)				
EMP039 (Australia)	Gen-01	1	CO2	A

	EMP040 (Norway)				
	EMP043 (Japan)				
	EMP045 (Brazil)	Gen-01	1	CO2	A
		Gen-02	1	CO2	A
	EMP047 (Sweden)				
	EMP048 (Germany)	Gen-01	1		
	EMP051 (Austria)				
	EMP053 (Poland)	Gen-01	1	CO2	A
		Gen-02	-	-	
	EMP054 (Austria)	Gen-01	0		
	EMP055 (United States)	Gen-01	1	CO2	A
		Gen-02	1		
	EMP056 (Switzerland)				
	EMP058 (Brazil)	Gen-01	1	CO2	A
		Gen-02	-	-	

Summary

Grouping	Legend	Quantity
Grouping A	CO2	17
Grouping B	CO2 + Foam	1
Grouping C	Water	4
Grouping D	None	1
Total of answered questions		**23**

[Back to Question]

D 1.5.2.2 Check-Box

1.5.2.2) Did the fire protection system work according to the design specification?

Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	**1**	1	0	0	0
New Zealand	**2**	0	7	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	0	0	3	0
Sweden	**4**	0	1	3	0
Norway	**1**	0	0	1	0
Canada	**3**	3	0	0	0
China	**1**	0	1	0	0
Spain	**1**	0	0	1	0
Russia	**1**	1	0	0	0
Japan	**3**	0	0	3	0
Germany	**1**	1	0	0	0
Brazil	**7**	5	0	3	0
United States	**1**		2	0	0
Mexico	**2**	2	0	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	13	11	**14**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	1	0	0	0

Macedonia	**1**	1	0	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	0	2	0
Total Observer Members (4)	**4**	2	0	**2**	**1**
Total Sum (20)	**35**	15	11	**16**	**3**

NOTE 1: this table already considers the answers of the "form for multiple machines".

[Back to Question]

D 1.5.2.3 Check-Box

1.5.2.3) Was the fire extinguished solely by the installed generator fire protection system without any additional external help?

Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	**1**	0	1	0	0
New Zealand	**2**	6	2	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	0	0	3	0
Sweden	**4**	0	1	3	0
Norway	**1**	0	0	1	0
Canada	**3**	3	0	0	0
China	**1**	1	0	0	0
Spain	**1**	0	0	1	0
Russia	**1**	1	0	0	0
Japan	**3**	0	0	3	0
Germany	**1**	0	1	0	0
Brazil	**7**	5	0	3	0
United States	**1**	0	2	0	0
Mexico	**2**	2	0	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	18	7	**14**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	1	0	0	0
Macedonia	**1**	1	0	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	0		2	0
Total Observer Members (4)	**4**	2	0	**2**	**1**
Total Sum (20)	**35**	20	7	**16**	**3**

NOTE 1: this table already considers the answers of the "form for multiple machines".

[Back to Question]

D 1.5.2.4 Check-Box

1.5.2.4) Did the fire spread outside the generator?

Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	**1**	0	1	0	0
New Zealand	**2**	0	8	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	0	0	3	0

Sweden	**4**	0	1	3	0
Norway	**1**	0	0	1	0
Canada	**3**	0	3	0	0
China	**1**	0	1	0	0
Spain	**1**	0	0	1	0
Russia	**1**	0	1	0	0
Japan	**3**	0	0	3	0
Germany	**1**	1	0	0	0
Brazil	**7**	0	5	3	0
United States	**1**	0	2	0	0
Mexico	**2**	0	2	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	1	24	**14**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0
Macedonia	**1**	0	1	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	1	1	0
Total Observer Members (4)	**4**	0	3	**1**	**1**
Total Sum (20)	**35**	1	27	**15**	**3**

NOTE 1: this table already considers the answers of the "form for multiple machines".

[Back to Question]

D 1.5.2.5 Open question

Question	Company		YES	Answer	Grouping
1.5.2.5) Give a brief description of the damage to the generator and surrounding:	EMP048 (Germany)	Gen-01	1	Contamination, damages of coal brushes	B
	EMP039 (Australia)	Gen-01	1	Exciter and brush holders damage	B
	EMP054 (Austria)	Gen-01	-	Approx. 17 % of the stator winding had to be replaced.	A
	EMP051 (Austria)				
	EMP013 (Brazil)				
	EMP008 (Brazil)				
	EMP016 (Brazil)				
	EMP058 (Brazil)	Gen-01	1	The rotor totally damaged and the stator partial damaged. The rotor was fixed definitively and the stator was partial fixed until to be possible changed it for a new one.	C
		Gen-02	-		
	EMP020 (Brazil)	Gen-01	1		
		Gen-02	-		
		Gen-03	-		
		Gen-04	-		
		Gen-05	-		
	EMP025 (Brazil)	Gen-01	1		

	EMP045 (Brazil)	Gen-01	1	Damage of several bars of the generator, damage of electrically passive components from the generator and stator.	A
		Gen-02	1		
	EMP010 (Canada)	Gen-01	1	Generator received damage to 134 of the 756 stator bars installed.	A
	EMP032 (Canada)	Gen-01	1	Upper windings damage and CT's PT' damage	A
		Gen-02	-		
		Gen-03	-		
		Gen-04	-		
		Gen-05	-		
		Gen-06	-		
		Gen-07	-		
		Gen-08	-		
		Gen-09	-		
		Gen-10	-		
		Gen-11	-		
		Gen-12	-		
	EMP036 (Canada)	Gen-01	1	None - contained within enclosure	E
		Gen-02	-		
		Gen-03	-		
		Gen-04	-		
		Gen-05	-		
	EMP021 (China)	Gen-01	0	The main lead and neutral lead termination connection as well as over hundred stator bars.	A
	EMP023 (Spain)				
	EMP009 (Japan)				
	EMP028 (Japan)				
	EMP043 (Japan)				
	EMP027 (Macedonia)	Gen-01	1	Insulation of stator winding, magnetic core and mechanical damage of insulation of rotor pole	C
		Gen-02	-		
		Gen-03	-		
		Gen-04	-		
		Gen-05	-		
	EMP012 (Mexico)	Gen-01	1	Damage to the upper stator winding endings with the presence of melted copper and damage to the cover plates.	A
		Gen-02	-		
		Gen-03	-		
		Gen-04	-		
		Gen-05	-		

	EMP031 (Mexico)	Gen-01	1	Damage to the windings and to the laminations with the presence of molten copper.	A
		Gen-02	-		
		Gen-03	-		
		Gen-04	-		
		Gen-05	-		
		Gen-06	-		
		Gen-07	-		
		Gen-08	-		
	EMO040 (Norway)				
	EMP015 (New Zealand)	Gen-01	0	Damage confined to a section of the bottom end winding - copper lost and fire damage to a little under a third of circumference. Insurance claim – 18 month outage – new core and winding.	A
		Gen-02	0	There was significant copper lost and fire damage to the top end winding area of the machine, extending approx 1/2 way around the stator. Insurance claim - 12 month outage – rewind only.	A
		Gen-03	0	There was some copper lost in phase lead and fire damage to approximately a third of the top end winding.	A
		Gen-04	0	There was some copper lost in phase lead and fire damage to approximately a third of the top end winding.	A
		Gen-05	0	The fire was contained within the generator winding enclosure. Outside the 20 year timeframe, but was intense fire causing extensive damage that took me 18 months to repair. Winding removed -cleaned – reinsulated and rewound.	A
		Gen-06	0	The fire was contained within the generator winding enclosure.	A
	EMP033 (New Zealand)	Gen-01	0	2/3rds of the generator stator windings were damaged and had to be replaced.	A
		Gen-02	0	Damage was minimal, but required a significant clean up effort inside the generator enclosure.	**D**
	EMP053 (Polonia)	Gen-01	1	Damaged 6.5% of stator bars.	A
		Gen-02	-		
	EMP037 (Russia)	Gen-01	1	Damage of stator winding.	A
	EMP019 (Sweden)	Gen-01	0	Probably one or two earth faults.	F
	EMP026 (Sweden)				
	EMP038 (Sweden)				
	EMP047 (Sweden)				
	EMP005 (Switzerland)				
	EMP006				

	(Switzerland)				
	EMP056 (Switzerland)				
	EMP055 (USA)	Gen-01	0	Winding insulation and ring bus damage.	A
		Gen-02	0		
Already considering the data from the form for multiple machines					

Categories		
A	Stator winding damage	17
B	Excitation slip rings and/or brushes damage	2
C	Rotor and stator winding damage	2
D	Little damage but great cleaning work.	1
E	Fire remained contained inside the generator housing	1
F	Answer does not match the subject asked	1

[Back to Question]

D 1.5.2.6 Check-Box

1.5.2.6) Were there any direct or indirect fatalities as a result of the fire started in the generator?

Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	**1**	0	1	0	0
New Zealand	**2**	0	8	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	0	0	3	0
Sweden	**4**	1	0	3	0
Norway	**1**	0	0	1	0
Canada	**3**	0	3	0	0
China	**1**	0	1	0	0
Spain	**1**	0	0	1	0
Russia	**1**	0	1	0	0
Japan	**3**	0	0	3	0
Germany	**1**	0	1	0	0
Brazil	**7**	0	4	4	0
United States	**1**	0	2	0	0
Mexico	**2**	0	2	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	1	23	**15**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0
Macedonia	**1**	0	1	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	1	1	0
Total Observer Members (4)	**4**	0	3	**1**	**1**
Total Sum (20)	**35**	1	26	**16**	**3**

NOTE 1: this table already considers the answers of the "form for multiple machines".

[Back to Question]

D 1.5.2.7 Check-Box

1.5.2.7) Was the fire protection designed to trigger automatically in an event of a fire or/and heat detection?

Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	**1**	1	0	0	0
New Zealand	**2**	8	0	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	0	0	3	0
Sweden	**4**	0	1	3	0
Norway	**1**	0	0	1	0
Canada	**3**	3	0	0	0
China	**1**	1	0	0	0
Spain	**1**	0	0	1	0
Russia	**1**	1	0	0	0
Japan	**3**	0	0	3	0
Germany	**1**	1	0	0	0
Brazil	**7**	2	1	3	0
United States	**1**	2	0	0	0
Mexico	**2**	2	0	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	21	2	**14**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0
Macedonia	**1**	1	0	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	1	1	0
Total Observer Members (4)	**4**	1	2	**1**	**1**
Total Geral (20)	**35**	22	4	**15**	**3**

NOTE 1: this table already considers the answers of the "form for multiple machines".

[Back to Question]

D 1.6 Check-Box

1.6) Do you have different types of fire protection systems within the generators installed in your power plants?

Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	**1**	0	1	0	0
New Zealand	**2**	2	0	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	3	0	0	0
Sweden	**4**	2	2	0	0
Norway	**1**	0	1	0	0
Canada	**3**	1	2	0	0
China	**1**	1	0	0	0
Spain	**1**	0	1	0	0
Russia	**1**	0	1	0	0
Japan	**3**	0	3	0	0
Germany	**1**	0	1	0	0
Brazil	**7**	0	6	1	0
United States	**1**	0	1	0	0
Mexico	**2**	1	1	0	0

France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**10**	**20**	**1**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0
Macedonia	**1**	0	1	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	2	0	0	0
Total Observer Members (4)	**4**	**2**	**2**	**0**	**1**
Total Sum (20)	**35**	**12**	**22**	**1**	**3**

[Back to Question]

D 1.6.1 Check-Box

1.6.1) If no, please indicate which is your sole fire protection system:

Regular Members	**Answers**	**CO^2**	**Water Spray**	**Inergen**	**Other**	**Blank**	**N. Answ**
Australia	**1**	0	1	0	1	0	0
New Zealand	**2**	0	0	0	0	0	0
United Kingdom	**0**	0	0	0	0	0	1
Switzerland	**3**	0	0	0	0	0	0
Sweden	**4**	2	0	0	0	2	0
Norway	**1**	1	0	0	0	0	0
Canada	**3**	0	2	0	0	1	0
China	**1**	0	0	0	0	0	0
Spain	**1**	1	0	0	0	0	0
Russia	**1**	0	1	0	0	0	0
Japan	**3**	0	0	0	3	0	0
Germany	**1**	0	0	0	1	0	0
Brazil	**7**	6	0	0	0	1	0
United States	**1**	1	0	0	0	0	0
Mexico	**2**	1	1	0	0	1	0
France	**0**	0	0	0	0	0	1
Total Regular Members (16)	**31**	**12**	**5**	**0**	**5**	**5**	**2**
Observer Members	**Answers**	**CO^2**	**Water Spray**	**Inergen**	**Other**	**Blank**	**N. Answ**
Poland	**1**	1	0	0	0	0	0
Macedonia	**1**	1	0	0	0	0	0
Belgium	**0**	0	0	0	0	0	1
Austria	**2**	0	0	0	0	0	0
Total Observer Members (4)	**4**	**2**	**0**	**0**	**0**	**0**	**1**
Total Sum (20)	**35**	**14**	**5**	**0**	**5**	**5**	**3**

[Back to Question]

D 1.6.1 Open question

Question	**Company**	**Result**	
		Answer	**Quant**
If other please indicate here which:	EMP005 (Switzerland)		0
	EMP006 (Switzerland)		0
	EMP008 (Brazil)		0
	EMP009 (Japan)	We do not use the GFP, while we have some fire extinguishers in power house.	1

EMP010 (Canada)		0
EMP012 (Mexico)		0
EMP013 (Brazil)		0
EMP015 (New Zealand)		0
EMP016 (Brazil)		0
EMP058 (Brazil)		0
EMP019 (Sweden)		0
EMP020 (Brazil)		0
EMP021 (China)		0
EMP053 (Poland)		0
EMP023 (Spain)		0
EMP025 (Brazil)		0
EMP026 (Sweden)		0
EMP027 (Macedonia)		0
EMP028 (Japan)	Dry-chemical extinguisher in portable execution for manual application (no fix system installation). We have over 200 hydro generators. Those capacities are about 100kW to 300,000kW.	1
EMP031 (Mexico)		0
EMP032 (Canada)		0
EMP033 (New Zealand)		0
EMP056 (Switzerland)		0
EMP036 (Canada)		0
EMP037 (Russia)		0
EMP038 (Sweden)		0
EMP039 (Australia)	CO2 has been removed and water based suppression is being installed on selected units. Water based fire suppression currently being installed on the following Hydro generators Tumut 1 generators (4x 82.4MW), Tumut 2 generators (4x 71.6MW). Planning to install water based fire suppression at Tumut 3 (6x 250MW), Murray 1 (10x 95MW), Murray 2 (4x 138MW) & Guthega (2x 30MW).	1
EMP040 (Norway)		0
EMP043 (Japan)	Fire extinguisher	1
EMP045 (Brazil)		0
EMP055 (EUA)		0
EMP047 (Sweden)		0
EMP048 (Germany)	NO2 gas	1
EMP054 (Austria)		0
EMP051 (Austria)		0

[Back to Question]

D 1.6.2 Check-Box

1.6.2) If yes, please indicate which are you're the different fire protection systems you have installed:

Regular Members	Answers	CO^2	Water Spray	Inergen	Other	Blank	N. Answ
Australia	**1**	0	0	0	0	0	0
New Zealand	**2**	2	1	1	0	0	0
United Kingdom	**0**	0	0	0	0	0	1
Switzerland	**3**	3	2	3	1	0	0
Sweden	**4**	2	0	0	1	2	0

Norway	**1**	0	0	0	0	0	0
Canada	**3**	1	1	0	1	2	0
China	**1**	1	1	0	0	0	0
Spain	**1**	0	0	0	0	0	0
Russia	**1**	0	0	0	0	0	0
Japan	**3**	0	0	0	0	0	0
Germany	**1**	0	0	0	0	0	0
Brazil	**7**	0	0	0	0	0	0
United States	**1**	0	0	0	0	0	0
Mexico	**2**	1	1	0	1	1	0
France	**0**	0	0	0	0	0	1
Total Regular Members (16)	**31**	**10**	**6**	**4**	**4**	**5**	**2**
Observer Members	**Answers**	**CO^2**	**Water Spray**	**Inergen**	**Other**	**Blank**	**N. Answ**
Poland	**1**	0	0	0	0	0	0
Macedonia	**1**	0	0	0	0	0	0
Belgium	**0**	0	0	0	0	0	1
Austria	**2**	2	1	0	2	0	0
Total Observer Members (4)	**4**	**2**	**1**	**0**	**2**	**0**	**1**
Total Sum (20)	**35**	**12**	**7**	**4**	**6**	**5**	**3**

D 1.6.2 Open question - consolidation

1.6.2) If yes, please indicate which are you're the different fire protection systems you have installed:					
Company	**CO2**	**Water Spray**	**Inergen**	**Other units number**	**Others description**
EMP005 (Switzerland)	Blank	Blank	Blank	Blank	Blank
EMP006 (Switzerland)	15	Blank	6	Blank	Blank
EMP015 (New Zealand)	4	8	Blank	Blank	Blank
EMP019 (Sweden)	no actual figure available too many	Blank	Blank	no quantity indication	Relay protection + VESDA
EMP021 (China)	3	Almost the generator in China apply water spray.	Blank	Blank	Blank
EMP026 (Sweden)	1	Blank	Blank	Blank	do not match with the question
EMP031 (Mexico)	6	2	Blank	no quantity indication	Foam
EMP032 (Canada)	2	78	Blank	Blank	Blank
EMP033 (New Zealand)	32	Blank	7	Blank	Blank
EMP056 (Switzerland)	14	1	38	1	N2
EMP054 (Austria)	22	Blank	Blank	246	4 Dry fire fighting pipe + 242 without GFP
EMP051 (Austria)	2	2		no quantity indication	All other units have no GFP
Quantity	101	91	51		

[Back to Question]

D 1.6.2 Open question - 1

Question	**Company**	**Result**		
		Answer	**Quant**	**Quantity**
CO_2: how many units?	EMP005 (Switzerland)	Blank	1	
	EMP006 (Switzerland)	15	1	15
	EMP015 (New Zealand)	4	1	4

	EMP019 (Sweden)	no actual figure available too many	1	
	EMP021 (China)	Only two or three generator, very seldom.	1	3
	EMP026 (Sweden)	1	1	1
	EMP031 (Mexico)	6	1	6
	EMP032 (Canada)	2	1	2
	EMP033 (New Zealand)	32	1	32
	EMP056 (Switzerland)	14	1	14
	EMP054 (Austria)	22	1	22
	EMP051 (Austria)	Two	1	2
		12 Companies added more than		101

D 1.6.2 Open question - 2

Question	Company	Result		
		Answer	**Quant**	**Quantity**
Water Spray: how many units?	EMP005 (Switzerland)	Em Branco	1	
	EMP015 (New Zealand)	8	1	8
	EMP021 (China)	Almost the generator in China apply water spray.	1	
	EMP031 (Mexico)	2	1	2
	EMP032 (Canada)	78	1	78
	EMP056 (Switzerland)	1	1	1
	EMP051 (Austria)	Two	1	2
		07 Companies added more than		91

D 1.6.2 Open question - 3

Question	Company	Result			
		Answer	**Quant**	**%**	**Quantity**
Inergen: how many units?	EMP005 (Switzerland)		1		0
	EMP006 (Switzerland)	6	1		6
	EMP033 (New Zealand)	7	1		7
	EMP056 (Switzerland)	38	1		38
		04 Companies added more than			51

D 1.6.2 Open question - 4

Question	Company	Result	
		Answer	**Quant**
Other: how many units?	EMP019 (Sweden)		0
	EMP031 (Mexico)		0
	EMP032 (Canada)		0
	EMP056 (Switzerland)	1	1
	EMP054 (Austria)	4 Dry fire fighting pipe	1
	EMP051(Austria)		0

D 1.6.2 Open question -5

Question	Company	Result	
		Answer	**Quant**
If other please indicate here which:	EMP005 (Switzerland)		0
	EMP006 (Switzerland)		0
	EMP008 (Brazil)		0
	EMP009 (Japan)		0
	EMP010 (Canada)		0
	EMP012 (Mexico)		0

EMP013 (Brazil)		0
EMP015 (New Zealand)		0
EMP016 (Brazil)		0
EMP019 (Sweden)	On some of our bitumen windings we have CO2 fire protection. We are trying to take these away and replace them with high quality relay protection sometimes combined with smoke sniffers. No water or Inergen or others if these sniffers don't counts. Fortum have 241 HPP so it is difficult to tell the real number of CO2 systems but they are fewer all the time and there are no CO2 systems or others when the winding is of epoxy type..	1
EMP020 (Brazil)		0
EMP021 (China)		0
EMP023 (Spain)		0
EMP025 (Brazil)		0
EMP026 (Sweden)		0
EMP027 (Macedonia)		0
EMP028 (Japan)		0
EMP031 (Mexico)	espuma	1
EMP032 (Canada)	Please note that we have 78 Hydroelectric and 2 combustion Turbines (CT Units). These two CT units are equipped with CO2 enforced by the CT supplier.	1
EMP033 (New Zealand)		0
EMP036 (Canada)		0
EMP037 (Russia)		0
EMP038 (Sweden)		0
EMP039 (Australia)		0
EMP040 (Norway)		0
EMP043 (Japan)		0
EMP045 (Brazil)		0
EMP047 (Sweden)		0
EMP048 (Germany)		0
EMP051 (Austria)	All other units of our organisation are NOT equipped with a fire protection system	1
EMP053 (Poland)		0
EMP054 (Austria)	242 units have no fire protection system.	1
EMP055 (EUA)		0
EMP056 (Switzerland)	N2	1
EMP058 (Brazil)		0

D 1.6.3 Check-Box

1.6.3) In the case of CO² please indicate the pressure system used:					
Regular Members	**Answers**	**High pressure**	**Low pressure**	**Blank**	**N. Answ**
Australia	**1**	0	0	1	0
New Zealand	**2**	2	0	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	2	1	0	0
Sweden	**4**	2	1	1	0
Norway	**1**	0	0	1	0
Canada	**3**	1	0	2	0

China	**1**	0	0	1	0
Spain	**1**	1	0	0	0
Russia	**1**	0	0	1	0
Japan	**3**	0	0	3	0
Germany	**1**	0	0	1	0
Brazil	**7**	6	0	1	0
United States	**1**	1	0	0	0
Mexico	**2**	1	1	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**16**	**3**	**12**	**2**
Observer Members	**Answers**	**High pressure**	**Low pressure**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0
Macedonia	**1**	1	0	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	2	0	0	0
Total Observer Members (4)	**4**	**3**	**1**	**0**	**1**
Total Geral (20)	**35**	**19**	**4**	**12**	**3**

[Back to Question]

D 1.6.3 Open question

Question	Company	Result		Pressure as indicated
		Answer	**Quant**	
Any comment on this issue?	EMP005 (Switzerland)		0	
	EMP006 (Switzerland)		0	
	EMP008 (Brazil)		0	
	EMP009 (Japan)		0	
	EMP010 (Canada)		0	
	EMP012 (Mexico)		0	
	EMP013 (Brazil)		0	
	EMP015 (New Zealand)	Will eventually be removed and replaced with a water fogging system, but not a high priority at this stage. We have removed the CO2 from the other station because it released more into the lower galleries than into the machine enclosure and posed a signification risk to staff on the station, if working at lower levels when the CO2 was discharged.	1	
	EMP016 (Brazil)	We use both, high and low pressure systems in different power plants.	1	H & L
	EMP019 (Sweden)		0	
	EMP020 (Brazil)		0	
	EMP021 (China)		0	
	EMP023 (Spain)		0	
	EMP025 (Brazil)		0	
	EMP026 (Sweden)		0	
	EMP027 (Macedonia)		0	
	EMP028 (Japan)		0	
	EMP031		0	

	(Mexico)			
	EMP032 (Canada)		0	
	EMP033 (New Zealand)	High pressure CO2 systems comprising CO2 cylinder banks.	1	H
	EMP036 (Canada)		0	
	EMP037 (Russia)		0	
	EMP038 (Sweden)		0	
	EMP039 (Australia)		0	
	EMP040 (Norway)	Depends to supplier	1	H & L
	EMP043 (Japan)		0	
	EMP045 (Brazil)	Normally the system pressure is 75 Kgf/cm2. This is considered as a good pratice among Brazilian power plants.	1	H
	EMP047 (Sweden)		0	
	EMP048 (Germany)		0	
	EMP051 (Austria)	These systems will be replaced	1	
	EMP053 (Poland)		0	
	EMP054 (Austria)		0	
	EMP055 (EUA)		0	
	EMP056 (Switzerland)		0	
	EMP058 (Brazil)	The high pressure system is used with pressure reduction in the generator housing.	1	H

[Back to Question]

D 1.6.4 Check-Box

1.6.4) Do you have generators with open circuit ventilation?					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	0	1	0	0
New Zealand	**2**	0	2	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	3	0	0	0
Sweden	**4**	3	1	0	0
Norway	**1**	1	0	0	0
Canada	**3**	1	2	0	0
China	**1**	1	0	0	0
Spain	**1**	1	0	0	0
Russia	**1**	0	1	0	0
Japan	**3**	2	1	0	0
Germany	**1**	1	0	0	0
Brazil	**7**	2	5	0	0
United States	**1**	0	1	0	0
Mexico	**2**	2	0	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**17**	**14**	**0**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0
Macedonia	**1**	1	0	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	1	1	0	0
Total Observer Members (4)	**4**	**2**	**2**	**0**	**1**

Total Sum (20)	**35**	**19**	**16**	**0**	**3**

[Back to Question]

D 1.6.4 Open question

Question	Company	Answer	Coding
If yes, which kind of fire protection, if any, do they have?	EMP005 (Switzerland)	None	D
	EMP006 (Switzerland)	CO2; Inergen	C
	EMP008 (Brazil)	Blank	H
	EMP009 (Japan)	No GFP	D
	EMP010 (Canada)	Blank	H
	EMP012 (Mexico)	No tienen protección automática, se aplica el CO2 manual con el generador parado	A
	EMP013 (Brazil)	Somente PCH's (pequenas centrais hidrelétrica)	G
	EMP015 (New Zealand)	Blank	H
	EMP016 (Brazil)	None.	D
	EMP019 (Sweden)	CO2 - Some old units have open air circulation but in these cases there are smoke "bars" that close when the CO2 system is activated providing a closed room for the extinguishing media required concentration to be established during the required amount of time.	A
	EMP020 (Brazil)	Blank	H
	EMP021 (China)	Blank	H
	EMP023 (Spain)	Blank	H
	EMP025 (Brazil)	Blank	H
	EMP026 (Sweden)	None	D
	EMP027 (Macedonia)	We have two Generators with power 9,5 MVA and they are in operation since 1959. The cooling system of the generator is open circuit ventilation with air. They have installed stationary fire protection with CO2 under the high pressure. The design for fire protection is to close inlet and outlet gate for cooling air and activate CO2 if fire will be detected in the generator by relay protection.	A
	EMP028 (Japan)	Dry-chemical extinguisher	B
	EMP031 (Mexico)	se aplica en forma manual CO2 y espuma	C
	EMP032 (Canada)	Blank	H
	EMP033 (New Zealand)	Blank	H
	EMP036 (Canada)	Water spray	F
	EMP037 (Russia)	Blank	H
	EMP038 (Sweden)	3 units with CO2	A
	EMP039 (Australia)	Blank	H
	EMP040 (Norway)	None	D
	EMP043 (Japan)	Blank	H
	EMP045 (Brazil)	Blank	H
	EMP047 (Sweden)	Blank	H
	EMP048 (Germany)	Temperature sensor, NO2 gas	E
	EMP051 (Austria)	Blank	H
	EMP053 (Poland)	Blank	H
	EMP054 (Austria)	None	D
	EMP055 (United States)	Blank	H
	EMP056 (Switzerland)	Water spray	F
	EMP058 (Brazil)	Blank	H

Summary

Grouping	Legend	Quantity
Grouping A	CO2	4

Grouping B	Dry Powder	1
Grouping C	CO2 and other - Foam or Inergen	2
Grouping D	No protection available	6
Grouping E	NO2	1
Grouping F	Water spay	2
Grouping G	Answer does not match the subject asked	1
Grouping H	Blank	18
Total of answered questions		**35**

[Back to Question]

D 1.7 Open question

Question	Company	Answer	Coding
1.7) In your opinion/experience what is the most efficient fire extinguishing media?	EMP005 (Switzerland)	Inergen	B
	EMP006 (Switzerland)	Inert gas	B
	EMP008 (Brazil)	CO2	A
	EMP009 (Japan)	Blank	F
	EMP010 (Canada)	water	C
	EMP012 (Mexico)	CO2	A
	EMP013 (Brazil)	Não deixar o fogo iniciar ou mesmo não deixar criar situações favoráveis para sua propagação (Prevenção)	D
	EMP015 (New Zealand)	Water fog	C
	EMP016 (Brazil)	CO2	A
	EMP019 (Sweden)	No experience	I
	EMP020 (Brazil)	CO2.	A
	EMP021 (China)	Water media is more efficient and safety.	C
	EMP023 (Spain)	Fireproof materials and CO2 fire protection systems.	A
	EMP025 (Brazil)	CO2	A
	EMP026 (Sweden)	Blank	F
	EMP027 (Macedonia)	gas CO2	A
	EMP028 (Japan)	No opinion	I
	EMP031 (Mexico)	CO2	A
	EMP032 (Canada)	water	C
	EMP033 (New Zealand)	water mist	C
	EMP036 (Canada)	CO2	A
	EMP037 (Russia)	Blank	F
	EMP038 (Sweden)	Blank	F
	EMP039 (Australia)	water	C
	EMP040 (Norway)	Water spray	C
	EMP043 (Japan)	Fire extinguisher	G
	EMP045 (Brazil)	For electric equipment: CO2 and	A
	EMP047 (Sweden)	Blank	F
	EMP048 (Germany)	gas	B
	EMP051 (Austria)	Blank	F
	EMP053 (Poland)	To low experience to give an opinion	I
	EMP054 (Austria)	Foam extinguisher	H
	EMP055 (United States)	CO2	A
	EMP056 (Switzerland)	dependent of Generator-type and Place	E
	EMP058 (Brazil)	CO2	A

Summary

Grouping	Legend	Quantity
Grouping A	CO2	12
Grouping B	Inergen (inert gas)	3
Grouping C	Water	7
Grouping D	Avoid fire begin (prevention)	1

Grouping E	Depends on type of application	1
Grouping F	Blank (no answer)	6
Grouping G	Fire Extinguisher	1
Grouping H	Foam extinguisher	1
Grouping I	No experience or no opinion	3
Total of answered questions		**35**

[Back to Question]

D 1.7.1 Open question

Question	Company	Answer	Coding
1.7.1) Which media is harmful to the machines?	EMP005 (Switzerland)	Water	C
	EMP006 (Switzerland)	gas	B
	EMP008 (Brazil)	Blank	H
	EMP009 (Japan)	Blank	H
	EMP010 (Canada)	Water	C
	EMP012 (Mexico)	Agua	C
	EMP013 (Brazil)	Blank	H
	EMP015 (New Zealand)	none if there has been a fire, water not good if there is an accidental discharge so effort put into the design to avoid this possibility	F
	EMP016 (Brazil)	Water	C
	EMP019 (Sweden)	Blank	H
	EMP020 (Brazil)	Blank	H
	EMP021 (China)	Blank	H
	EMP023 (Spain)	It is not defined any harmful to the machine because CO2 system.	F
	EMP025 (Brazil)	Water may cause corrosion in some cases.	C
	EMP026 (Sweden)	Blank	H
	EMP027 (Macedonia)	CO2	A
	EMP028 (Japan)	Water	C
	EMP031 (Mexico)	Agua	C
	EMP032 (Canada)	water to some extent if applied for a long duration i.e. >10 minutes	C
	EMP033 (New Zealand)	water mist or water deluge	C
	EMP036 (Canada)	Water	C
	EMP037 (Russia)	water spray	C
	EMP038 (Sweden)	Blank	H
	EMP039 (Australia)	Blank	H
	EMP040 (Norway)	Halon?	B
	EMP043 (Japan)	water spray	C
	EMP045 (Brazil)	Chemical dust XXXXXXX	E
	EMP047 (Sweden)	water spray	C
	EMP048 (Germany)	gas - water - e-mail correction	D
	EMP051 (Austria)	Blank	H
	EMP053 (Poland)	To low experience to give an opinion	G
	EMP054 (Austria)	Water	C
	EMP055 (United States)	Water	C
	EMP056 (Switzerland)	none	F
	EMP058 (Brazil)	Water	C

Summary

Grouping	Legend	Quantity
Grouping A	CO2	1
Grouping B	Gas or Halon	2
Grouping C	Water	16
Grouping D	Gas - Water	1
Grouping E	Chemical Dust	1
Grouping F	Not defined or None	3

Grouping G	No experience or no opinion	1
Grouping H	Blank	10
Total of answered questions		**35**

[Back to Question]

D 1.7.2 Open question

Question	Company	Result		Alternatives indicated for this item							
		Answer	Quant	CO2	Halon	N2	Foam	any gas	C. Powder	Nothing	Blank
1.7.2) Which media is harmful to the human health?	EMP005 (Switzerland)	CO2	1	1							
	EMP006 (Switzerland)	Inert gas	1			1					
	EMP008 (Brazil)	CO2	1	1							
	EMP009 (Japan)	Blank	0								1
	EMP010 (Canada)	CO2	1	1							
	EMP012 (Mexico)	CO2	1	1							
	EMP013 (Brazil)	Blank	0								1
	EMP015 (New Zealand)	CO2 or any gas	1	1				1			
	EMP016 (Brazil)	CO2	1	1							
	EMP019 (Sweden)	CO2	1	1							
	EMP020 (Brazil)	CO2.	1	1	1						
	EMP021 (China)	CO2 gas	1	1							
	EMP023 (Spain)	CO2 is harmful to the human health because displacing of air, and it is necessary to remove CO2 of stator room before the entry of personnel to the stator area.	1	1							
	EMP025 (Brazil)	CO2	1	1							
	EMP026 (Sweden)	Blank	0								1
	EMP027 (Macedonia)	CO2	1	1							
	EMP028 (Japan)	CO2	1	1							
	EMP031 (Mexico)	CO2 y espuma	1	1			1				
	EMP032 (Canada)	CO2	1	1							
	EMP033 (New Zealand)	CO2	1	1							
	EMP036 (Canada)	CO2	1	1							
	EMP037 (Russia)	CO2	1	1							
	EMP038 (Sweden)	Blank	0								1
	EMP039 (Australia)	CO2	1	1							
	EMP040 (Norway)	CO2 and Halon	1	1	1						

	EMP043 (Japan)	CO2	1	1							
	EMP045 (Brazil)	Chemical dust, CO2, halogen composites	1	1	1				1		
	EMP047 (Sweden)	CO2	1	1							
	EMP048 (Germany)	gas (CO2 or N2)	1	1		1					
	EMP051 (Austria)	Blank	0								1
	EMP053 (Poland)	Nothing detected	1							1	
	EMP054 (Austria)	CO2, Halon…	1	1	1						
	EMP055 (EUA)	CO2	1	1							
	EMP056 (Switzerland)	CO2 and in high concentration N2	1	1		1					
	EMP058 (Brazil)	CO2	1	1							
			Total	28	4	3	1	1	1	1	5

[Back to Question]

D 1.7.3 Open question

Question	Company	Answer	Coding
1.7.3) Is there any environmental concern bound to any media currently in use?	EMP005 (Switzerland)	Yes	F
	EMP006 (Switzerland)	no	G
	EMP008 (Brazil)	no	G
	EMP009 (Japan)	No.	G
	EMP010 (Canada)	no	G
	EMP012 (Mexico)	No, si hay para gas halón	D
	EMP013 (Brazil)	Blank	H
	EMP015 (New Zealand)	Greenhouse gas	E
	EMP016 (Brazil)	no	G
	EMP019 (Sweden)	Blank	H
	EMP020 (Brazil)	No.	G
	EMP021 (China)	No, but water.	G
	EMP023 (Spain)	There is no any specific environmental concern about fire extinguishing media. It must be taken on consideration about evacuation of CO2 after tripping of fire protection systems.	A
	EMP025 (Brazil)	Blank	H
	EMP026 (Sweden)	Blank	H
	EMP027 (Macedonia)	Blank	H
	EMP028 (Japan)	Yes	F
	EMP031 (Mexico)	no	G
	EMP032 (Canada)	CO2 (Life Safety & Greenhouse gas)	A
	EMP033 (New Zealand)	Yes, the greenhouse gas potential of CO2, however this is considered very minor	A
	EMP036 (Canada)	We use water so the answer would be no.	G
	EMP037 (Russia)	no	G
	EMP038 (Sweden)	Blank	H
	EMP039 (Australia)	FM200	C
	EMP040 (Norway)	Yes for CO2 and halon	B
	EMP043 (Japan)	no	G
	EMP045 (Brazil)	no	G
	EMP047 (Sweden)	No, not as far as we know.	G
	EMP048 (Germany)	Blank	H

	EMP051 (Austria)	Blank	H
	EMP053 (Poland)	Not known	G
	EMP054 (Austria)	no	G
	EMP055 (United States)	CO2 may have harmful effect to worldwide greenhouse warming	A
	EMP056 (Switzerland)	no	G
	EMP058 (Brazil)	no	G

Summary

Grouping	Legend	Quantity
Grouping A	Yes for CO2	4
Grouping B	Yes for CO2 and Halon	1
Grouping C	Yes for FM200	1
Grouping D	Halon	1
Grouping E	Greenhouse gas - but no additional explanation given	1
Grouping F	Yes - but no additional explanation given	2
Grouping G	No concern	17
Grouping H	Blank (no answer)	8
Total of answered questions		**35**

[Back to Question]

D 1.8 Check-Box

1.8) Do you specify measures to prevent accidents to personnel?					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	1	0	0	0
New Zealand	**2**	2	0	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	3	0	0	0
Sweden	**4**	2	1	1	0
Norway	**1**	1	0	0	0
Canada	**3**	2	1	0	0
China	**1**	1	0	0	0
Spain	**1**	1	0	0	0
Russia	**1**	0	1	0	0
Japan	**3**	3	0	0	0
Germany	**1**	1	0	0	0
Brazil	**7**	6	0	1	0
United States	**1**	1	0	0	0
Mexico	**2**	1	1	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**25**	**4**	**2**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	1	0	0	0
Macedonia	**1**	1	0	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	1	1	0	0
Total Observer Members (4)	**4**	**3**	**1**	**0**	**1**
Total Sum (20)	**35**	**28**	**5**	**2**	**3**

[Back to Question]

D 1.8 Open question

1.8) Do you specify measures to prevent accidents to personnel?			
Question	**Company**	**Answer**	**Coding**
If yes, please specify:	EMP005 (Switzerland)	safety manual	A

	EMP006 (Switzerland)	Blank	N
	EMP008 (Brazil)	Interlocking	C
	EMP009 (Japan)	Fire Alarm, Emergency Exit Sing lighting.	F
	EMP010 (Canada)	There are health and safety programs in place.	A
	EMP012 (Mexico)	El sistema automático se bloquea cuando el personal entra al generador, opera una alarma al detectar una persona en el foso del generador, se extrae el CO2 cuando entra el personal al foso del generador. Se intervienen los aspersores sólo cuando está bloqueado el sistema.	C
	EMP013 (Brazil)	Política interna de prevenção de acidentes com normalização de uso de EPI's, sinalizações e anáise de risco da tarefa; os controles também são realizados também pelos órgaão federais competentes;	A
	EMP015 (New Zealand)	The normal fire alarm and red flashing lights. Planning to remove all CO2	L
	EMP016 (Brazil)	Automatic and manual CO2 block.	C
	EMP019 (Sweden)	Taking away CO2 when the relay protection is sufficient	J
	EMP020 (Brazil)	Don't came in the machine after CO2 discharge.	E
	EMP021 (China)	All the staff working inside the plant have more knowledge which is clearly indicate in the notice and regulation. They know how to protect themselves and move in correct direction and use the hydrant. They have well.	A
	EMP023 (Spain)	Blank	N
	EMP025 (Brazil)	Blank	N
	EMP026 (Sweden)	Blank	N
	EMP027 (Macedonia)	Generator in the chamber	M
	EMP028 (Japan)	CO2 extinguishing system is not acceptable.	D
	EMP031 (Mexico)	Blank	N
	EMP032 (Canada)	Put procedures and training in place	A
	EMP033 (New Zealand)	This question is too broad, do you mean to define this question to accidents related to generators?? Meridian has detailed Health & Safety procedures covering all works aspects carried out on our hydroelectric power station sites.	A
	EMP036 (Canada)	Blank	N
	EMP037 (Russia)	Blank	N
	EMP038 (Sweden)	Blank	N
	EMP039 (Australia)	isolation requirements and choice of Media	H
	EMP040 (Norway)	de-energize the fire protection system, if any	C
	EMP043 (Japan)	Fire door	G
	EMP045 (Brazil)	it is not allowed to get inside the housing when the fire protection system is activated; specific training programs for the Fire Brigade; creation of appropriate routes for fire escape.	I
	EMP047 (Sweden)	Before entrance in to a generator with CO2 you have disconnect a breaker manual to prevent unintentional release of CO2-gas.	C
	EMP048 (Germany)	Safety measures for working on active parts	A
	EMP051 (Austria)	Blank	N
	EMP053 (Poland)	During generator overhaul mechanical stoppers are installed on CO2 valves to prevent CO2 injection into generator interior when people are working.	C
	EMP054 (Austria)	Use of non flammable insulating material, brazing, automatic fire detection systems, implementation of fire compartments in the power plant.	K

	EMP055 (United States)	Audible warning for individuals to evacuate the area	B
	EMP056 (Switzerland)	Blockierung der Löschanlagen befor der zu schützende Raum betreten werden kann	I
	EMP058 (Brazil)	The door of access to the hydro generator housing is blocked when the machine is in operation. So, the fire protection is blocked when personnel is inside the machine housing.	C

Summary

Grouping	Legend	Quantity
Grouping A	People trained according to regulations, accident prevention policy	7
Grouping B	Audible warning for evacuation of the area	1
Grouping C	Automatic and manual (CO2) interlocking, disconnect system before going in to room - for inspection or maintenance	7
Grouping D	CO2 systems are not acceptable	1
Grouping E	Forbid to enter housing after CO2 discharge	1
Grouping F	Fire alarm and emergency exit lightning	1
Grouping G	Fire Door	1
Grouping H	Isolation requirements and choice of media	1
Grouping I	Forbid access to CO2 protected areas when system is activated	2
Grouping J	Eliminate CO2 systems when relay system is sufficient	1
Grouping K	Implementation of fire compartments on power plants	1
Grouping L	Planning to remove CO2	1
Grouping M	Answer does not match the subject asked	1
Grouping N	Blank	9
Total of answered questions		**35**

[Back to Question]

D 1.8.1 Check-Box

1.8.1) Do you specify measures to prevent damage to machine?					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	1	0	0	0
New Zealand	**2**	2	0	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	2	1	0	0
Sweden	**4**	2	2	0	0
Norway	**1**	0	1	0	0
Canada	**3**	3	0	0	0
China	**1**	0	1	0	0
Spain	**1**	0	0	1	0
Russia	**1**	0	1	0	0
Japan	**3**	3	0	0	0
Germany	**1**	1	0	0	0
Brazil	**7**	3	3	1	0
United States	**1**	1	0	0	0
Mexico	**2**	2	0	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**20**	**9**	**2**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0
Macedonia	**1**	1	0	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	1	1	0	0
Total Observer Members (4)	**4**	**2**	**2**	**0**	**1**
Total Sum(20)	**35**	**22**	**11**	**2**	**3**

[Back to Question]

D 1.8.1 Open question

1.8.1) Do you specify measures to prevent damage to machine?			
Question	**Company**	**Answer**	**Coding**
If yes, please specify:	EMP005 (Switzerland)	Operating manual	F
	EMP006 (Switzerland)	Blank	L
	EMP008 (Brazil)	Blank	L
	EMP009 (Japan)	Overcurrent Relay.	A
	EMP010 (Canada)	There are relay protection schemes installed on the unit.	A
	EMP012 (Mexico)	Los aspersores de CO2 no deben estar cerca del generador, a más de 1 m de la estructura del generador, nunca dentro del estator.	D
	EMP013 (Brazil)	Todas unidades geradoras no país são monitoradas e fiscalizadas por órgão/agencias fererais competentes;	I
	EMP015 (New Zealand)	Installing VESDA detection systems and require both a VESDA level 4 activation plus a differential protection relay operation before water is actually discharged into the generator. There is a manual discharge capability, but it still requires the VESDA level four activiation.	C
	EMP016 (Brazil)	Blank	L
	EMP019 (Sweden)	Blank	L
	EMP020 (Brazil)	Blank	L
	EMP021 (China)	Blank	L
	EMP023 (Spain)	Blank	L
	EMP025 (Brazil)	Blank	L
	EMP026 (Sweden)	Blank	L
	EMP027 (Macedonia)	measurement of temperature of winding, magnetic core	E
	EMP028 (Japan)	Water extinguishing system is not acceptable	K
	EMP031 (Mexico)	las espreas deben estar a una distancia adecuada de el generador	D
	EMP032 (Canada)	Proper interlocking schemes and manualfire extinguishing measures during annual maintenance	G
	EMP033 (New Zealand)	it is unclear what specifically the question refers to. Meridian has many practices and procedures in place to "prevent damage to machine".	F
	EMP036 (Canada)	When deluge operates machine is removed from service immediately.	A
	EMP037 (Russia)	Blank	L
	EMP038 (Sweden)	Restricted access by means of information and alarm	H
	EMP039 (Australia)	two fire detections required before water released. (1-thermal and electric fault, and 2-smoke hi level and thermal)	A
	EMP040 (Norway)	Blank	L
	EMP043 (Japan)	Fire door	B
	EMP045 (Brazil)	Blank	L
	EMP047 (Sweden)	Blank	L
	EMP048 (Germany)	Temperature of winding, iron core and air. Ozone concentration.	E
	EMP051 (Austria)	Blank	L
	EMP053 (Poland)	Blank	L
	EMP054 (Austria)	Use of non flammable insulating material, brazing	J
	EMP055 (United States)	High resistance grounding to limit ground fault currents, protective relays for differential currents and rotor grounds	A
	EMP056 (Switzerland)	Fire-protection-system	A

	EMP058 (Brazil)	All protection is done by automatic protection system independent of personal action. Manual protection is used when the operator is sure of fire existence and system was failure	A

Summary

Grouping	Legend	Quantity
Grouping A	Automatic protection, relays, release start interlocks	7
Grouping B	Fire door	1
Grouping C	Use of special detection (VESDA)	1
Grouping D	Keep CO2 sprays distant from machine components	2
Grouping E	Monitoring of machine values, temperatures, ozone levels, etc.	2
Grouping F	Following manuals	2
Grouping G	Safety prevention during maintenance	1
Grouping H	Access restriction	1
Grouping I	Inspection by external authorities	1
Grouping J	Use of non flammable material	1
Grouping K	Water extinction is not acceptable	1
Grouping L	Blank	15
Total of answered questions		**35**

[Back to Question]

D 1.9 Check-Box

1.9) By what means is the existing generator fire extinguishing system is designed to release?

Regular Members	Answers	Automatically	Manually	Either automatic or manual	Blank	N. Answ
Australia	**1**	1	0	0	0	0
New Zealand	**2**	0	0	2	0	0
United Kingdom	**0**	0	0	0	0	1
Switzerland	**3**	3	0	0	0	0
Sweden	**4**	1	0	3	0	0
Norway	**1**	1	0	0	0	0
Canada	**3**	2	0	1	0	0
China	**1**	0	0	1	0	0
Spain	**1**	0	0	1	0	0
Russia	**1**	1	0	0	0	0
Japan	**3**	0	1	0	2	0
Germany	**1**	1	0	0	0	0
Brazil	**7**	1	0	5	1	0
United States	**1**	0	0	1	0	0
Mexico	**2**	1	0	1	0	0
France	**0**	0	0	0	0	1
Total Regular Members (16)	**31**	**12**	**1**	**15**	**3**	**2**
Observer Members	**Answers**	**Automatically**	**Manually**	**Either automatic or manual**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0	0
Macedonia	**1**	0	1	0	0	0
Belgium	**0**	0	0	0	0	1
Austria	**2**	0	1	1	0	0
Total Observer Members (4)	**4**	**0**	**3**	**1**	**0**	**1**
Total Sum (20)	**35**	**12**	**4**	**16**	**3**	**3**

[Back to Question]

D 1.9.1 Open question

Question	Company	Answer	Coding
1.9.1) What is your opinion or preferred method, as to how the generator fire extinguishing system should be released?	EMP005 (Switzerland)	combination	C
	EMP006 (Switzerland)	Blank	J
	EMP008 (Brazil)	temperature associated with generator electrical protection	H
	EMP009 (Japan)	Blank	J
	EMP010 (Canada)	automatic	A
	EMP012 (Mexico)	Automático	A
	EMP013 (Brazil)	Blank	J
	EMP015 (New Zealand)	Installing VESDA detection systems and require both a VESDA level 4 activation plus a differential protection relay operation before water is actually discharged into the generator. There is a manual discharge capability, but it still requires the VESDA level four activation.	E
	EMP016 (Brazil)	Manually or automatically. If automatically, by thermal sensors, subjected to the generator differential relay operation.	F
	EMP019 (Sweden)	Automatic or manual	C
	EMP020 (Brazil)	Automatic system extinguishing.	A
	EMP021 (China)	We prefer to operate the system with fully automatic, ,semi-automatic and in combination with manual method.	C
	EMP023 (Spain)	Both	C
	EMP025 (Brazil)	Automatically, with the possibility of manual trigger.	C
	EMP026 (Sweden)	Blank	J
	EMP027 (Macedonia)	manual and auto	C
	EMP028 (Japan)	Blank	J
	EMP031 (Mexico)	sistema automatico	A
	EMP032 (Canada)	automatic	A
	EMP033 (New Zealand)	The preferred method is either automatic or manual.	C
	EMP036 (Canada)	Must have a heat activated detector and split phase operation	G
	EMP037 (Russia)	automatically	A
	EMP038 (Sweden)	Blank	J
	EMP039 (Australia)	automatic as station are not manned	A
	EMP040 (Norway)	If any: Automatic, provided de-energized when personnel in the power station	D
	EMP043 (Japan)	Manually	B
	EMP045 (Brazil)	We understand that the system should be automatic and also should have the option to be released manually.	A
	EMP047 (Sweden)	automatic	A
	EMP048 (Germany)	automatically	A
	EMP051 (Austria)	Blank	J
	EMP053 (Poland)	To less experience	I
	EMP054 (Austria)	Manually	B
	EMP055 (United States)	automatically	A
	EMP056 (Switzerland)	Automatically or manually	C
	EMP058 (Brazil)	It should be released automatically.	A

Summary

Grouping	Legend	Quantity
Grouping A	Automatic	12
Grouping B	Manual	2
Grouping C	Automatic or manual (some with semi-automatic alternative)	8
Grouping D	When provided with GFP than automatic provided that is will be de-energized when personnel in in the power station	1
Grouping E	Automatic or manual but with VESDA (smoke detector) level 4 activation	1
Grouping F	Automatic or manual but with thermal sensors interlock	1
Grouping G	Must have activated detectors and split phase operation	1
Grouping H	Temperature and generator relay interlock for actuation	1

Grouping I	Too little experience	1
Grouping J	Blank	7
Total of answered questions		**35**

[Back to Question]

D 1.10 Check-Box

1.10) How is the fire detected in your generators? Please tick the box.

Regular Members	Answers	Heat	Smoke	Manual (By personnel)	Generator Electrical Protection relay operation plus one of above device operation	Any other	Blank	N. Answ
Australia	**1**	1	1	0	1	0	0	0
New Zealand	**2**	1	2	1	2	0	0	0
United Kingdom	**0**	0	0	0	0	0	0	1
Switzerland	**3**	3	2	2	2	1	0	0
Sweden	**4**	3	2	0	1	1	0	0
Norway	**1**	1	1	0	0	0	0	0
Canada	**3**	2	2	0	2	0	0	0
China	**1**	1	1	1	1	0	0	0
Spain	**1**	1	1	0	0	0	0	0
Russia	**1**	0	0	0	1	0	0	0
Japan	**3**	3	3	1	0	0	0	0
Germany	**1**	1	1	1	1	0	0	0
Brazil	**7**	4	3	2	6	1	1	0
United States	**1**	1	0	1	1	0	0	0
Mexico	**2**	1	2	1	0	0	0	0
France	**0**	0	0	0	0	0	0	1
Total Regular Members (16)	**31**	**23**	**21**	**10**	**18**	**3**	**1**	**2**
Observer Members	**Answers**	**Heat**	**Smoke**	**Manual (By personnel)**	**Generator Electrical Protection relay operation plus one of above device operation**	**Any other**	**Blank**	**N. Answ**
Poland	**1**	0	0	1	0	0	0	0
Macedonia	**1**	0	0	0	1	0	0	0
Belgium	**0**	0	0	0	0	0	0	1
Austria	**2**	1	2	1	0	0	0	0
Total Observer Members (4)	**4**	**1**	**2**	**2**	**1**	**0**	**0**	**1**
Total Sum (20)	**35**	**24**	**23**	**12**	**19**	**3**	**1**	**3**

[Back to Question]

D 1.10 Open question

Question	Company	Result	
		Answer	**Quant**
please specify:	EMP005 (Switzerland)	Blank	0
	EMP006 (Switzerland)	Blank	0
	EMP008 (Brazil)	Blank	0
	EMP009 (Japan)	Blank	0

	EMP010 (Canada)	Blank	0
	EMP012 (Mexico)	Blank	0
	EMP013 (Brazil)	Blank	0
	EMP015 (New Zealand)	Blank	0
	EMP016 (Brazil)	Blank	0
	EMP019 (Sweden)	Blank	0
	EMP020 (Brazil)	Blank	0
	EMP021 (China)	Blank	0
	EMP023 (Spain)	Blank	0
	EMP025 (Brazil)	Blank	0
	EMP026 (Sweden)	nitrite	1
	EMP027 (Macedonia)	Blank	0
	EMP028 (Japan)	Blank	0
	EMP031 (Mexico)	Blank	0
	EMP032 (Canada)	Blank	0
	EMP033 (New Zealand)	Blank	0
	EMP036 (Canada)	Blank	0
	EMP037 (Russia)	Blank	0
	EMP038 (Sweden)	Blank	0
	EMP039 (Australia)	Blank	0
	EMP040 (Norway)	Blank	0
	EMP043 (Japan)	Blank	0
	EMP045 (Brazil)	optical - sensor of cloudy	1
	EMP047 (Sweden)	Blank	0
	EMP048 (Germany)	Blank	0
	EMP051 (Austria)	Blank	0
	EMP053 (Poland)	Blank	0
	EMP054 (Austria)	Blank	0
	EMP055 (EUA)	Blank	0
	EMP056 (Switzerland)	Smoke not by all- there are some generators that do not have smoke detectors due to the room temperature that is too high for these sensors.	1
	EMP058 (Brazil)	Blank	0

[Back to Question]

D 1.10.1 Open question

Question	Company	Answer	Coding
1.10.1) Do you have any comment about the efficiency of these detectors (heat and/or smoke)?	EMP005 (Switzerland)	Blank	J
	EMP006 (Switzerland)	BKW is using heat detectors for the protection of the machine only. There is no comparison of the efficiency available.	F
	EMP008 (Brazil)	Blank	J
	EMP009 (Japan)	Smoke detectors sometimes malfunction.	B
	EMP010 (Canada)	No problems with the currently installed smoke detectors. These detectors were installed within the last 6 years.	A
	EMP012 (Mexico)	No se consiguen fácilmente desde el punto de vista comercial. Se traen del extranjero	I
	EMP013 (Brazil)	Blank	J
	EMP015 (New Zealand)	Blank	J
	EMP016 (Brazil)	No	G
	EMP019 (Sweden)	Blank	J
	EMP020 (Brazil)	No	G

	EMP021 (China)	How to prevent influence from vibration or electromagnetic field to the precise measurement of these detectors is our problem.	I
	EMP023 (Spain)	There is no experience of fire with no tripping of fire systems detectors. In all the cases, fire detectors trips appropriately.	F
	EMP025 (Brazil)	In one unit, an improper discharge of CO2 and trip occurred due to the incorrect operation of thermal and smoke detectors	E
	EMP026 (Sweden)	Blank	J
	EMP027 (Macedonia)	Blank	J
	EMP028 (Japan)	No comment	G
	EMP031 (Mexico)	detectores de fuego o de humo	I
	EMP032 (Canada)	Install two system: Incipient or early warning to alert the operator without deluge operation and smoke detection interlocked with "86 lock-out " electrical protection	I
	EMP033 (New Zealand)	Smoke detection is seen as the most efficient as very small levels of smoke particles indicating the very early stages of a fire can be sensed by an aspirating smoke sensing system. For thermal detection to operate the temperature within the generator enclosure or windings themselves needs to reach much higher elevated levels before activating the generator fire protection system. This takes a considerable longer time compared to the activation time provided by smoke detection which may result in considerable more fire damage to the generator. Meridian employ an efficient automatic detection system using a voting system whereby any two of heat, smoke or generator electrical protection systems needs to be true to initiate an activation of the fire protection system. This also reduces the amount of accidental activations of the generator fire protection system.	C
	EMP036 (Canada)	Have been very reliable	D
	EMP037 (Russia)	Blank	J
	EMP038 (Sweden)	Important with dry "cord"	I
	EMP039 (Australia)	Smoke is the most prone to false initiation. Need aspirating system in generators due to high air flows. Use VESDA and require a high level of smoke to trip suppression and alarms at low levels of smoke.	C
	EMP040 (Norway)	Smoke detector has proven efficient in other cases also, such as core ending overheating	A
	EMP043 (Japan)	Blank	J
	EMP045 (Brazil)	Both are not efficient enough. We believe that the most appropriate is combine the several detectors and the electric protection of the generators.	E
	EMP047 (Sweden)	modern type "sniffers" is very efficient	A
	EMP048 (Germany)	These systems are don't covering the slip ring system.	I
	EMP051 (Austria)	Blank	J
	EMP053 (Poland)	Generator rotor is a very effective fan hance CO2 can be released after rotor is stooped otherwise CO2 is blown out from stator interior.	I
	EMP054 (Austria)	We have usual faulty activation (shuld a falut occur the activation happens). In case of emergency (fire accident) the activation should work.	I
	EMP055 (United States)	The currently available smoke detectors are unreliable	B
	EMP056 (Switzerland)	No	G
	EMP058 (Brazil)	The detector of smoke most used contains Am-241, a radioactive material. The dioxide of Am-241 in solubre form is potentially dangerous. It must be used carefully.	H

Summary

Grouping	Legend	Quantity

Grouping A	Standard Smoke detectors are reliable	3
Grouping B	Standard Smoke detectors are NOT reliable	2
Grouping C	Smoke detectors by aspiration (VESDA) are more reliable	2
Grouping D	Both smoke and thermal are reliable	1
Grouping E	Both smoke and thermal are NOT reliable	2
Grouping F	No comparison available	2
Grouping G	No comment	4
Grouping H	Smoke with radioactive elements require special handling care	1
Grouping I	Answer does not match the subject asked	8
Grouping J	Blank	10
Total of answered questions		**35**

[Back to Question]

D 1.11 Open question

Question	Company	Answer	Coding
1.11) How do you prevent unwanted (unnecessary-accidental) release of generator fire extinguishing system? (Eg- dual detection method) Please specify here:	EMP008 (Brazil)	dual detection method	Grouping A
	EMP010 (Canada)	There is dual operation in order to release the extinguishing system. The conditions that must be met are: the Generator differential protection must operate plus the operation of one smoke detector.	Grouping A
	EMP012 (Mexico)	Una detección de temperatura y mínimo dos de humo	Grouping A
	EMP031 (Mexico)	detección de temperatura y detección de humo	Grouping A
	EMP036 (Canada)	Dual detection	Grouping A
	EMP047 (Sweden)	dual detection	Grouping A
	EMP054 (Austria)	We have 3 circuits of heat and smoke detector in the generator ring area (inside the generator housing). If 2 circuits are activated the extinguishing system starts. If the door of the generator ring (housing) area is open the CO2 extinguishing system is blocked.	Grouping A
	EMP056 (Switzerland)	dual detection method	Grouping A
	EMP006 (Switzerland)	There is no protection for unwanted release existing	Grouping B
	EMP015 (New Zealand)	Installing VESDA detection systems and require both a VESDA level 4 activation plus a differential protection relay operation before water is actually discharged into the generator. There is a manual discharge capability, but it still requires the VESDA level four activation.	Grouping C
	EMP016 (Brazil)	The system is released only if the generator differential relay operates.	Grouping D
	EMP025 (Brazil)	Connection of fire protection control panel output in series with generator electrical protection relays.	Grouping D
	EMP032 (Canada)	Same as 1.10.1 of the above	Grouping D
	EMP045 (Brazil)	Tractebel try to prevent unwanted release of the system using the information of the sensors integrated with the electric protection of the generator.	Grouping D
	EMP019 (Sweden)	The CO2 system is blocked when there is work going on inside the generator i.e. inspection.	Grouping E
	EMP023 (Spain)	By blocking fire detection signals during outages and maintenance tasks.	Grouping E
	EMP055 (EUA)	Clearance system (lockout-tagout), manual "off" switch and manual blocking of release devices.	Grouping E
	EMP053 (Poland)	Mechanical stoppers during generator overhaul	Grouping F
	EMP027 (Macedonia)	Manually activated	Grouping G

	EMP033 (New Zealand)	Dual detection method employing a voting system, see answer to Q1.10.1 above.	Grouping H
	EMP039 (Australia)	New water based fire suppression system will have two fire detections required before water released. (thermal and electric fault, and smoke hi level and thermal). Each generator will have each control board to reduce risk of multiple releases.	Grouping H
	EMP043 (Japan)	We check the fire alarm at a certain intervals.	Grouping I
	EMP048 (Germany)	periodic check	Grouping I
	EMP021 (China)	The fire extinguishing system will be released in case of: a) Some of setling smoke detectors actuated; b) Some of setling heat detectors actuated; c)Differential and or neutral protection already tripped off; d)Circuit breaker of high voltage side of main transformer and de-escalation breaker already tripped off.	Grouping J
	EMP005 (Switzerland)	Did not answer	Grouping K
	EMP009 (Japan)	Did not answer	Grouping K
	EMP013 (Brazil)	Did not answer	Grouping K
	EMP026 (Sweden)	Did not answer	Grouping K
	EMP028 (Japan)	Did not answer	Grouping K
	EMP037 (Russia)	Did not answer	Grouping K
	EMP038 (Sweden)	Did not answer	Grouping K
	EMP040 (Norway)	Did not answer	Grouping K
	EMP051 (Austria)	Did not answer	Grouping K

Legends of the Groupings of Answers

Grouping	Legend	Quantity
Grouping A	Dual protection	8
Grouping B	No protection for unwanted trip	1
Grouping C	VESDA detection system	1
Grouping D	Include generator electrical protection (e.g. Differential Relay)	4
Grouping E	Block CO2 at inspection works	3
Grouping F	Mechanical stoppers	1
Grouping G	Manual activation	1
Grouping H	Voting system involving two out of smoke or heat detectors, or electrical protection	2
Grouping I	Check fire alarms in intervals	2
Grouping J	Trip occurs if any of the available detectors (heat or smoke) or electrical protection actuates	1
Grouping K	Did not answer	9

[Back to Question]

D 1.11.1 Check-Box

1.11.1) At your present installation did you have unwanted (unnecessary-accidental) release of generator fire extinguishing system with consequent release of extinguishing media?

Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	**1**	1	0	0	0
New Zealand	**2**	2	0	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	2	1	0	0
Sweden	**4**	1	2	1	0
Norway	**1**	0	1	0	0
Canada	**3**	2	1	0	0
China	**1**	0	1	0	0

Spain	**1**	1	0	0	0
Russia	**1**	0	1	0	0
Japan	**3**	1	0	2	0
Germany	**1**	1	0	0	0
Brazil	**7**	5	1	1	0
United States	**1**	1	0	0	0
Mexico	**2**	0	2	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**17**	**10**	**4**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0
Macedonia	**1**	1	0	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	1	1	0	0
Total Observer Members (4)	**4**	**2**	**2**	**0**	**1**
Total Sum (20)	**35**	**19**	**12**	**4**	**3**

[Back to Question]

D 1.11.1 Open questions (summarizes the 3 open questions made)

1.11.1) How do you prevent unwanted (unnecessary-accidental) release of generator fire extinguishing system? Please specify here:

Company	1.11.1-1 - Number of unwanted (unnecessary-accidental) releases of fire protection per unit per year:	1.11.1-2 - Outage duration that resulted due to clean up:	1.11.1-3 - If you know the reason of these incidents, please specify?
EMP005 (Switzerland)	Blank	Blank	Blank
EMP006 (Switzerland)	approx. 15 since 1981	6 hours	Blank
EMP008 (Brazil)	1	Blank	accidental
EMP009 (Japan)	Blank	Blank	Blank
EMP010 (Canada)	Blank	Blank	Blank
EMP012 (Mexico)	Blank	Blank	Blank
EMP013 (Brazil)	Blank	Blank	Blank
EMP015 (New Zealand)	The CO2 system was prone to accidental releases, usually human error, made worse by the fact that it was not a dual activation system.	1 hour	human error
EMP016 (Brazil)	Blank	Blank	Blank
EMP019 (Sweden)	Blank	Blank	Blank
EMP020 (Brazil)	Blank	8 hours	Blank
EMP021 (China)	Blank	Blank	Blank

EMP023 (Spain)	0,004	Blank	Un-adverted tripping of master relays during protection relays testings.
EMP025 (Brazil)	0,004 (2 releases in 20 units in 24 years)	2h 04min	The first unwanted release occured due to a short-circuit in the GFP board. In the second case, an improper discharge of CO2 and trip occured due to the incorrect operation of thermal and smoke detectors.
EMP026 (Sweden)	Blank	Blank	Blank
EMP027 (Macedonia)	Blank	6 hours	electrical damage outside the generator
EMP028 (Japan)	Blank	Blank	Blank
EMP031 (Mexico)	Blank	Blank	Blank
EMP032 (Canada)	>6	7 to 90 days	Welder working in the vicininty of a unit (created smoke) and generator happened to trip on electrical fault, thus triggering the water deluge
EMP033 (New Zealand)	Typicallly, one accidental release every 7 years across 39 generator units = 0.004 accidental release per unit per year.	10 hours	varies, typically false activation of smoke and/or thermal detection system.
EMP036 (Canada)	5 in the last 20 years	7 days or more	Blank
EMP037 (Russia)	Blank	Blank	Blank
EMP038 (Sweden)	Blank	Blank	Blank
EMP039 (Australia)	In the past we had one per year CO2 releases- particularly where smoke was one of the inputs and release is managed by a central fire board. We have removed all CO2 installations and now in the process of installing water based protection on selected unit	4 hours	oil casing smoke
EMP040 (Norway)	Blank	Blank	Blank
EMP043 (Japan)	One or less	Blank	Blank

EMP045 (Brazil)	0,03 releases / year for each generator	4 hours	They are: sensor defect, human accidental operation, problems with de CO2 system components.
EMP047 (Sweden)	1 release in 20 years	1 day	testing of relay protection, fault in CO2 relay system or detection system
EMP048 (Germany)	Multiple release because of unwanted activation of electrical protection.	Blank	Blank
EMP051 (Austria)	Blank	Blank	Blank
EMP053 (Poland)	Blank	Blank	Blank
EMP054 (Austria)	0,05	0,5 days	faulty activation of protection system
EMP055 (EUA)	Unknown	1 to 3 days	false signal
EMP056 (Switzerland)	2 in 20 year	0,5 days	faulty manual operation
EMP058 (Brazil)	The number per year of unwanted releases of fire protection is about 0.5/year.	3 days	Personnal failure operation and same ocourance of false protection operation during comissioning

[Back to Question]

D 1.12 Check-Box

1.12) In an event of fire is detected by the devices installed (eg. Smoke, heat etc), will extinguishing media release immediately without any delay or any manual interference?

Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	**1**	1	0	0	0
New Zealand	**2**	0	2	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	2	1	0	0
Sweden	**4**	2	0	2	0
Norway	**1**	1	0	0	0
Canada	**3**	3	0	0	0
China	**1**	1	0	0	0
Spain	**1**	1	0	0	0
Russia	**1**	1	0	0	0
Japan	**3**	1	0	2	0
Germany	**1**	1	0	0	0
Brazil	**7**	3	3	1	0
United States	**1**	1	0	0	0
Mexico	**2**	2	0	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**20**	**6**	**5**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0
Macedonia	**1**	0	1	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	1	1	0	0

Total Observer Members (4)	**4**	**1**	**3**	**0**	**1**
Total Sum (20)	**35**	**21**	**9**	**5**	**3**

[Back to Question]

D 1.12 Open question

Question	Company	Answer	Coding
If No, please inform the steps of releasing the extinguishing media:	EMP005 (Switzerland)	Blank	E
	EMP006 (Switzerland)	Blank	E
	EMP008 (Brazil)	Blank	E
	EMP009 (Japan)	Blank	E
	EMP010 (Canada)	Blank	E
	EMP012 (Mexico)	Blank	E
	EMP013 (Brazil)	Blank	E
	EMP015 (New Zealand)	Installing VESDA detection systems and require both a VESDA level 4 activation plus a differential protection relay operation before water is actually discharged into the generator. There is a manual discharge capability, but it still requires the VESDA level four activation.	D
	EMP016 (Brazil)	The system is released only if the generator differential relay operates.	D
	EMP019 (Sweden)	Blank	E
	EMP020 (Brazil)	Blank	E
	EMP021 (China)	Blank	E
	EMP023 (Spain)	Blank	E
	EMP025 (Brazil)	There is a 60-second delay	C
	EMP026 (Sweden)	Blank	E
	EMP027 (Macedonia)	operator will activated the fire protection	B
	EMP028 (Japan)	Blank	E
	EMP031 (Mexico)	Blank	E
	EMP032 (Canada)	Blank	E
	EMP033 (New Zealand)	wait 30 seconds before discharging extinguishing media	C
	EMP036 (Canada)	Blank	E
	EMP037 (Russia)	Blank	E
	EMP038 (Sweden)	Blank	E
	EMP039 (Australia)	Blank	E
	EMP040 (Norway)	Blank	E
	EMP043 (Japan)	Blank	E
	EMP045 (Brazil)	Usually it occurs in two steps: first occurs one discharge immediately (fast discharge) and then occur what we call slow discharge to extinguish totally the fire. Both steps are automatic.	D
	EMP047 (Sweden)	Blank	E
	EMP048 (Germany)	Blank	E
	EMP051 (Austria)	Blank	E
	EMP053 (Poland)	The hydro unit is first stopped than CO2 is injected manually released.	B
	EMP054 (Austria)	Alarm, time delay	C
	EMP055 (United States)	Blank	E
	EMP056 (Switzerland)	akustischer und optischer Alarm	A
	EMP058 (Brazil)	Blank	E

Summary

Grouping	Legend	Quantity
Grouping A	Alarm (acoustic and optical) comes prior to release	1
Grouping B	Manual release	2
Grouping C	Time delay for release	3
Grouping D	Answer does not match the subject asked	3
Grouping E	Blank	26

Total of answered questions	35

[Back to Question]

D 1.13 Check-Box

1.13) Do you consider bearings as a potential fire hazard for generators?					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	0	1	0	0
New Zealand	**2**	0	2	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	2	1	0	0
Sweden	**4**	0	4	0	0
Norway	**1**	0	1	0	0
Canada	**3**	0	3	0	0
China	**1**	0	1	0	0
Spain	**1**	1	0	0	0
Russia	**1**	1	0	0	0
Japan	**3**	1	2	0	0
Germany	**1**	1	0	0	0
Brazil	**7**	1	6	0	0
United States	**1**	1	0	0	0
Mexico	**2**	0	2	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**8**	**23**	**0**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0
Macedonia	**1**	0	1	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	2	0	0
Total Observer Members (4)	**4**	**0**	**4**	**0**	**1**
Total Sum (20)	**35**	**8**	**27**	**0**	**3**

[Back to Question]

D 1.13.1 Check-Box

1.13.1) Are your generator fire protection systems designed to fight bearing fires?						
Regular Members	**Answers**	**Yes**	**No**	**Do not know**	**Blank**	**N. Answ**
Australia	**1**	0	1	0	0	0
New Zealand	**2**	1	1	0	0	0
United Kingdom	**0**	0	0	0	0	1
Switzerland	**3**	1	1	1	0	0
Sweden	**4**	1	1	2	0	0
Norway	**1**	0	1	0	0	0
Canada	**3**	0	3	0	0	0
China	**1**	0	1	0	0	0
Spain	**1**	1	0	0	0	0
Russia	**1**	0	0	1	0	0
Japan	**3**	1	2	0	0	0
Germany	**1**	0	1	0	0	0
Brazil	**7**	0	7	0	0	0
United States	**1**	0	0	1	0	0
Mexico	**2**	0	2	0	0	0

France	**0**	0	0	0	0	1
Total Regular Members (16)	**31**	**5**	**21**	**5**	**0**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Do not know**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0	0
Macedonia	**1**	0	1	0	0	0
Belgium	**0**	0	0	0	0	1
Austria	**2**	0	1	1	0	0
Total Observer Members (4)	**4**	**0**	**3**	**1**	**0**	**1**
Total Sum (20)	**35**	**5**	**24**	**6**	**0**	**3**

[Back to Question]

D 1.14 Check-Box

1.14) Do you specify provisions to remove fire extinguishing media?					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	1	0	0	0
New Zealand	**2**	2	0	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	2	1	0	0
Sweden	**4**	0	2	2	0
Norway	**1**	0	1	0	0
Canada	**3**	1	2	0	0
China	**1**	1	0	0	0
Spain	**1**	1	0	0	0
Russia	**1**	0	1	0	0
Japan	**3**	0	3	0	0
Germany	**1**	1	0	0	0
Brazil	**7**	2	4	1	0
United States	**1**	1	0	0	0
Mexico	**2**	1	1	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**13**	**15**	**3**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	1	0	0	0
Macedonia	**1**	1	0	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	1	1	0
Total Observer Members (4)	**4**	**2**	**1**	**1**	**1**
Total Sum (20)	**35**	**15**	**16**	**4**	**3**

[Back to Question]

D 1.14 Open question -1

Question	Company	Answer	Coding
If yes, for water–spray: does it include provisions for decontamination in case of water used for extinguishing a fire? Please specify here:	EMP005 (Switzerland)	Blank	C
	EMP006 (Switzerland)	NA	B
	EMP008 (Brazil)	Blank	C
	EMP009 (Japan)	Blank	C
	EMP010 (Canada)	The water spray drains into a drainage sump and is filtered through a oil-water separator. Then only the water is pumped out into the surge chamber which runs out into the tailrace tunnel.	A
	EMP012 (Mexico)	No	B
	EMP013 (Brazil)	Blank	C

	EMP015 (New Zealand)	For water fog limited water is discharged and machine would require a dry out of surface water. Water would normal only be discharged when there had been a genuine fire.	B
	EMP016 (Brazil)	Blank	C
	EMP019 (Sweden)	Blank	C
	EMP020 (Brazil)	Blank	C
	EMP021 (China)	First, the water will be removed by several holes located in stator frame floor. Then the windings will be dried by heater, blower and electric power, .etc.	B
	EMP023 (Spain)	Blank	C
	EMP025 (Brazil)	Blank	C
	EMP026 (Sweden)	Blank	C
	EMP027 (Macedonia)	Blank	C
	EMP028 (Japan)	Blank	C
	EMP031 (Mexico)	Blank	C
	EMP032 (Canada)	Blank	C
	EMP033 (New Zealand)	Blank	C
	EMP036 (Canada)	Blank	C
	EMP037 (Russia)	Blank	C
	EMP038 (Sweden)	Blank	C
	EMP039 (Australia)	Drainage of water. Decontamination by station oil separator. Minimize oil loss from bearings by placing thrower on shaft above bearings.	A
	EMP040 (Norway)	Blank	C
	EMP043 (Japan)	Blank	C
	EMP045 (Brazil)	Blank	C
	EMP047 (Sweden)	Blank	C
	EMP048 (Germany)	Blank	C
	EMP051 (Austria)	Blank	C
	EMP053 (Poland)	Blank	C
	EMP054 (Austria)	Blank	C
	EMP055 (United States)	Blank	C
	EMP056 (Switzerland)	Blank	C
	EMP058 (Brazil)	Blank	C

Summary

Grouping	Legend	Quantity
Grouping A	Drainage of water to decontamination - oil water separator	2
Grouping B	No decontamination foreseen	4
Grouping C	Blank	29
Total of answered questions		**35**

[Back to Question]

D 1.14 Open question - 2

Question	Company	Answer	Coding
If yes, for CO2: do you have an exhaust system that removes the media out of the room? Please specify here:	EMP005 (Switzerland)	Blank	E
	EMP006 (Switzerland)	Yes.	A
	EMP008 (Brazil)	Blank	E
	EMP009 (Japan)	Blank	E
	EMP010 (Canada)	Blank	E
	EMP012 (Mexico)	Extractores eléctricos	A
	EMP013 (Brazil)	Blank	E
	EMP015 (New Zealand)	For CO2 we have extraction fan that clear the CO2 from the lower galleries as it drains down.	A

	EMP016 (Brazil)	The CO2 exhaustion systems that we have are composed by exhausters and pipes that lead the internal generator air to the outside of the power house. The system is operated manually when a CO2 discharge occurs, to allow the removal of the same from the interior of the generator housing.	C
	EMP019 (Sweden)	Blank	E
	EMP020 (Brazil)	Blank	E
	EMP021 (China)	First, all the openings located in the generator pit, top cover and lower cover will be closed on usual. Then all the gas will be exhausted by fans, the purification of pit will be checked by special device, etc. Training will performed by routine way.	A
	EMP023 (Spain)	CO2 is removed from the stator room to the hall with air forced ventilation systems. The hall of the power plant is good enough ventilated and the CO2 is removed to the exterior.	A
	EMP025 (Brazil)	Blank	E
	EMP026 (Sweden)	Blank	E
	EMP027 (Macedonia)	vented machinery room	B
	EMP028 (Japan)	Blank	E
	EMP031 (Mexico)	Blank	E
	EMP032 (Canada)	Blank	E
	EMP033 (New Zealand)	for CO2 systems, some of Meridian's existing generator units have dedicated CO2 extract systems that are manually remote operated to extract residual CO2 present within the generator enclosure after the fire has been extinguished. Meridian are in the process of upgrading existing generator CO2 systems. For existing CO2 extract systems these will remain. For generator units that do not have CO2 extract systems employed, they will not be installed as part of the upgrade.	B
	EMP036 (Canada)	Blank	E
	EMP037 (Russia)	Blank	E
	EMP038 (Sweden)	Blank	E
	EMP039 (Australia)	For our removed CO2 system we didn't have exhaust system	A
	EMP040 (Norway)	Blank	E
	EMP043 (Japan)	Blank	E
	EMP045 (Brazil)	There is no specific system to remove the media. Normally is used portable coolers and natural ventilation.	A
	EMP047 (Sweden)	Blank	E
	EMP048 (Germany)	Blank	E
	EMP051 (Austria)	Blank	E
	EMP053 (Poland)	Yes, special exhaust system to remove CO2 out of the machine hall.	A
	EMP054 (Austria)	Blank	E
	EMP055 (United States)	Do not have a dedicated system, but use a portable venting system.	B
	EMP056 (Switzerland)	separate Kanäle bis ins Freie	D
	EMP058 (Brazil)	Blank	E

Summary

Grouping	Legend	Quantity
Grouping A	Fix exhaust system	8
Grouping B	Portable exhaust system	3
Grouping C	Separate exhaust channels	1
Grouping D	No separate exhaust system available	1
Grouping E	Blank	22
Total of answered questions		**35**

[Back to Question]

D 1.15 Check-Box

1.15) Do you specify automatic open/close relief vents on the generator housing to relieve excessive inrush extinguishing media pressure while maintaining extinguishing media concentration within the generator housing for the specified extinguishing time?					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	0	1	0	0
New Zealand	**2**	1	1	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	2	1	0	0
Sweden	**4**	0	2	2	0
Norway	**1**	0	1	0	0
Canada	**3**	0	3	0	0
China	**1**	0	1	0	0
Spain	**1**	1	0	0	0
Russia	**1**	0	1	0	0
Japan	**3**	0	1	2	0
Germany	**1**	0	1	0	0
Brazil	**7**	4	2	1	0
United States	**1**	0	1	0	0
Mexico	**2**	0	2	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**8**	**18**	**5**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0
Macedonia	**1**	0	1	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	1	0	1	0
Total Observer Members (4)	**4**	**1**	**2**	**1**	**1**
Total Geral (20)	**35**	**9**	**20**	**6**	**3**

[Back to Question]

D 1.16 Open question (consolidates the two open questions made)

Company	**Result**		**Please specify the extinguishing media**				
	Answer and comments	**Only the number**	**CO_2**	**H_2O**	**N_2**	**Chem. Powder**	**Blank**
EMP005 (Switzerland)	Blank	-					1
EMP006 (Switzerland)	Blank	-					1
EMP008 (Brazil)	3	3	1				
EMP009 (Japan)	Blank	-					1
EMP010 (Canada)	11	11		1			
EMP012 (Mexico)	Una	1	1				
EMP013 (Brazil)	Blank	-					1
EMP015 (New Zealand)	8	8		1			
EMP016 (Brazil)	2	2	1				
EMP019 (Sweden)	1	1	1				
EMP020 (Brazil)	one machine	1	1				
EMP021 (China)	No limitation.	no limit		1			
EMP023 (Spain)	1	1	1				
EMP025 (Brazil)	2	2	1				
EMP026 (Sweden)	Blank	-					1
EMP027 (Macedonia)	4	4	1				
EMP028 (Japan)	Blank	-					1
EMP031 (Mexico)	6	6	1				

EMP032 (Canada)	12	12		1			
EMP033 (New Zealand)	7 units, served by an in-service bank of CO2 cylinders with a spare reserve bank of CO2 cylinders. The reserve bank is fully connected but requires manual switchover.	7	1				
EMP036 (Canada)	Any number	no limit		1			
EMP037 (Russia)	Blank	-					1
EMP038 (Sweden)	3	3	1				
EMP039 (Australia)	no maximum. size of supply to meet demand for one unit and manual fire fighting. redundancy to meet fire NFPA and Aust fire codes.	no limit		1			
EMP040 (Norway)	1	1	1				
EMP043 (Japan)	One	1				1	
EMP045 (Brazil)	2	2	1				
EMP047 (Sweden)	2	2	1				
EMP048 (Germany)	2	2			1		
EMP051 (Austria)	Blank	-					1
EMP053 (Poland)	2	2	1				
EMP054 (Austria)	4	4	1				
EMP055 (EUA)	4	4	1				
EMP056 (Switzerland)	1	1	1	1	1		
EMP058 (Brazil)	4	4	1				

[Back to Question]

D 1.16.1 Check-Box

1.16.1) Do you have main and reserve storage for each group of protected machines?					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	0	1	0	0
New Zealand	**2**	1	1	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	1	2	0	0
Sweden	**4**	1	2	1	0
Norway	**1**	0	1	0	0
Canada	**3**	1	2	0	0
China	**1**	0	1	0	0
Spain	**1**	1	0	0	0
Russia	**1**	0	0	1	0
Japan	**3**	0	1	2	0
Germany	**1**	1	0	0	0
Brazil	**7**	5	1	1	0
United States	**1**	1	0	0	0
Mexico	**2**	0	2	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**12**	**14**	**5**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	1	0	0	0
Macedonia	**1**	1	0	0	0

Belgium	**0**	0	0	0	1
Austria	**2**	1	1	0	0
Total Observer Members (4)	**4**	**3**	**1**	**0**	**1**
Total Geral (20)	**35**	**15**	**15**	**5**	**3**

[Back to Question]

D 1.16.1 Open question

Question	Company	Result	
		Answer	Quant
If yes, please specify here:	EMP005 (Switzerland)	Blank	0
	EMP006 (Switzerland)	Blank	0
	EMP008 (Brazil)	Blank	0
	EMP009 (Japan)	Blank	0
	EMP010 (Canada)	water storage basins	1
	EMP012 (Mexico)	Blank	0
	EMP013 (Brazil)	Blank	0
	EMP015 (New Zealand)	Blank	0
	EMP016 (Brazil)	Blank	0
	EMP019 (Sweden)	Blank	0
	EMP020 (Brazil)	Blank	0
	EMP021 (China)	Blank	0
	EMP023 (Spain)	Blank	0
	EMP025 (Brazil)	Blank	0
	EMP026 (Sweden)	Blank	0
	EMP027 (Macedonia)	Blank	0
	EMP028 (Japan)	Blank	0
	EMP031 (Mexico)	Blank	0
	EMP032 (Canada)	Blank	0
	EMP033 (New Zealand)	Blank	0
	EMP036 (Canada)	Blank	0
	EMP037 (Russia)	Blank	0
	EMP038 (Sweden)	Blank	0
	EMP039 (Australia)	Blank	0
	EMP040 (Norway)	Blank	0
	EMP043 (Japan)	Blank	0
	EMP045 (Brazil)	Blank	0
	EMP047 (Sweden)	Blank	0
	EMP048 (Germany)	Blank	0
	EMP051 (Austria)	Blank	0
	EMP053 (Poland)	1 reserve storage of CO2 bottles	1
	EMP054 (Austria)	Blank	0
	EMP055 (EUA)	Normally the reserve storage is extra bottles in the warehouse.	1
	EMP056 (Switzerland)	Blank	0
	EMP058 (Brazil)	Normally are used two groups, one reserve of the other.	1

[Back to Question]

D 1.17 Open question

Question	Company	Answer	Coding

1.17) What is the future trend for extinguishing media?	EMP005 (Switzerland)	Blank	L
	EMP006 (Switzerland)	Inert gas	F
	EMP008 (Brazil)	Blank	L
	EMP009 (Japan)	Blank	L
	EMP010 (Canada)	Water	B
	EMP012 (Mexico)	CO2	A
	EMP013 (Brazil)	serem adotados somente em equipamentos onde se faz realmente necessário, como exemplo transformadores elevadores a óleo, e não em hidrogeradores.	I
	EMP015 (New Zealand)	In my case water fog	B
	EMP016 (Brazil)	I do not see much possibility of evolution in terms of extinguishing agent, at least what is related to the protection of generators.	J
	EMP019 (Sweden)	Will be excluded	I
	EMP020 (Brazil)	Blank	L
	EMP021 (China)	At the moment, we still apply water as a appreciate media. An update media available for environment and no harmful for health is under research and study.	B
	EMP023 (Spain)	As it has been mentioned, fire protection systems have been removed according to the generator rewinding program depending on the age of the stator and according to the conditions of the insulation. At the same time of the rewinding process, insulations are removed using new fireproof materials.	I
	EMP025 (Brazil)	Blank	L
	EMP026 (Sweden)	Blank	L
	EMP027 (Macedonia)	Blank	L
	EMP028 (Japan)	Media in consideration of reduction of human damage and the greenhouse gas.	F
	EMP031 (Mexico)	CO2	A
	EMP032 (Canada)	Water deluge on thermoplastic windings	B
	EMP033 (New Zealand)	Meridian's intention is to maintain CO2 generator fire protection systems on Meridian's above ground power stations. For underground power stations Meridian's intention will be to provide a clean agent gas suppression systems such as Inergen or Argonite. In terms of international trends, we see that CO2 will be phased out due to its harmful affects to personnel, more gas suppression systems will employ gases such as Inergen and Argonite, and more water mist systems will be employed as generator insulation systems become more tolerant to moisture absorption.	G
	EMP036 (Canada)	Water	B
	EMP037 (Russia)	Blank	L
	EMP038 (Sweden)	Blank	L
	EMP039 (Australia)	Water	B
	EMP040 (Norway)	None	I
	EMP043 (Japan)	Fire extinguisher	C
	EMP045 (Brazil)	In the next few years we believe that will still be : chemical dust, CO2 and halogen composites.	E
	EMP047 (Sweden)	no extinguishing media	I
	EMP048 (Germany)	In my opinion, using of fire resistant insulation	I
	EMP051 (Austria)	Water	B
	EMP053 (Poland)	Not considered	K
	EMP054 (Austria)	foam extinguisher	D
	EMP055 (United States)	Unknown - possibly (1) alternate gas media, (2) water or (3) no fire suppression.	H
	EMP056 (Switzerland)	Inergen and Water	G
	EMP058 (Brazil)	Fire protection will not be used motivated by development of isolation system	I

Summary

Grouping	Legend	Quantity
Grouping A	CO2 - remains	2

Grouping B	Water - remains	7
Grouping C	Fire extinguisher (dry chemical powder) -remains	1
Grouping D	Foam extinguisher	1
Grouping E	New media like chemical dust, CO2 and halogen composites	1
Grouping F	Inert gas (INERGEN and alike)	2
Grouping G	Inert gas (INERGEN and alike) and water	2
Grouping H	Inert gas, water or none	1
Grouping I	NO fire protection at all	7
Grouping J	NO evolution foreseen	1
Grouping K	Answer does not match the subject asked	1
Grouping L	Blank	9
Total of answered questions		**35**

[Back to Question]

D 1.18 Open question

Question	Company	Answer	Coding
1.18) What is the future trend for fire detection?	EMP005 (Switzerland)	Blank	L
	EMP006 (Switzerland)	There is no trend for the future.	D
	EMP008 (Brazil)	Blank	L
	EMP009 (Japan)	We use both smoke and heat detector.	A
	EMP010 (Canada)	Smoke	C
	EMP012 (Mexico)	Temperatura y humo	A
	EMP013 (Brazil)	serem adotados somente em equipamentos e ou locais onde o fogo possa realmente ser uma ameça sem controle.	J
	EMP015 (New Zealand)	Again in my case VESDA smoke detection	B
	EMP016 (Brazil)	In terms of sensors, also I do not see many possibilities of future evolution.	D
	EMP019 (Sweden)	More smoke detection as a relay protection	C
	EMP020 (Brazil)	Blank	L
	EMP021 (China)	Blank	L
	EMP023 (Spain)	The trend is the next one: - In new machines there will no be installed any fire extinguishing system. New machines are specifyed with fireproof materials. Fire detection systems and remote alarm will be instaled. -In case of machines with no-fireproof materilas, the fire extingushing systems will be reviewed and in operation. -In case of refurbished machines with fireproof materials, the already installed fire extinguished systems will be kept , reviewed and in operation.	J
	EMP025 (Brazil)	Blank	L
	EMP026 (Sweden)	Blank	L
	EMP027 (Macedonia)	Blank	L
	EMP028 (Japan)	Same as ever (Smoke and heat)	A
	EMP031 (Mexico)	Fuego y humo	A
	EMP032 (Canada)	Incipient and early warning detection incombination with smoke/heat	H
	EMP033 (New Zealand)	more use of smoke sensing systems and combining them in automatic systems utilising thermal, smoke and electrical protection inputs.	E
	EMP036 (Canada)	HAD and Split phase	G
	EMP037 (Russia)	Blank	L
	EMP038 (Sweden)	One alternative may be to use electric arc detector	I
	EMP039 (Australia)	Blank	L
	EMP040 (Norway)	Smoke detectors	C
	EMP043 (Japan)	Fire alarm	K
	EMP045 (Brazil)	It looks that will be the integration of several signs of sensors and electric protections monitored by artificial intelligence (Fuzzy, neural nets).	E
	EMP047 (Sweden)	advanced smoke detectors(air pumps)	B

	EMP048 (Germany)	chemical analysis of cooling air	F
	EMP051 (Austria)	Sensors for heat and smoke	A
	EMP053 (Poland)	Not considered	K
	EMP054 (Austria)	Blank	L
	EMP055 (United States)	Multiple signals (e.g. differential relay, heat, etc.) in series before discharge of the suppression system.	E
	EMP056 (Switzerland)	Heat and smoke	A
	EMP058 (Brazil)	Same as 1.17	J

Summary

Grouping	Legend	Quantity
Grouping A	Heat and smoke detectors - remain	6
Grouping B	Advanced smoke detectors (VESDA)	2
Grouping C	Smoke detectors -remain	3
Grouping D	NO perspective of sensor's evolution	2
Grouping E	Combination of detectors and relays monitored by an automatic system (e.g.. artificial intelligence)	3
Grouping F	Chemical analysis of cooling air	1
Grouping G	HAD and split phase	1
Grouping H	Incipient and early detection in combination of heat and smoke	1
Grouping I	Electric arc detection	1
Grouping J	NO detection and NO GFP	3
Grouping K	Answer does not match the subject asked	2
Grouping L	Blank	10
Total of answered questions		**35**

[Back to Question]

D 1.19 Check-Box (Part 1)

1.19) In case of fire, smoke constitutes a major problem on visibility, orientation, breathing capacity, etc. Therefore it is desirable to provide adequate means of combating while involving minimum risk to personnel. In this line please check which additional provisions you do foresee in your plants:

Regular Members	Answers	routine personnel fire fighting and fire escape training	clearly indicated (illuminated large numbers located low) escape routes	breathing apparatus (with pertinent use training) or air line system	emergency lightning located low and personnel own miner type hand lamps	areas subject to CO^2 clearly indicated, with door interlocks, acoustic and visual alarms	use of odorized CO^2 only with routine crew recognition training on the fragrance used
Australia	**1**	1	1	1	0	0	0
New Zealand	**2**	1	1	1	1	1	1
United Kingdom	**0**	0	0	0	0	0	0
Switzerland	**3**	2	2	0	2	2	2
Sweden	**4**	3	3	3	3	3	0
Norway	**1**	1	1	1	1	1	1
Canada	**3**	3	3	3	2	2	0
China	**1**	1	1	1	1	1	0
Spain	**1**	1	1	1	1	1	0
Russia	**1**	1	1	0	0	0	0
Japan	**3**	2	3	2	3	0	0

Germany	**1**	0	1	1	1	0	0
Brazil	**7**	7	5	4	3	6	1
United States	**1**	1	1	1	1	0	1
Mexico	**2**	1	1	1	2	1	0
France	**0**	0	0	0	0	0	0
Total Regular Members (16)	**31**	**25**	**25**	**20**	**21**	**18**	**6**
Observer Members	**Answers**	**routine personnel fire fighting and fire escape training**	**clearly indicated (illuminated large numbers located low) escape routes**	**breathing apparatus (with pertinent use training) or air line system**	**emergency lightning located low and personnel own miner type hand lamps**	**areas subject to CO^2 clearly indicated, with door interlocks, acoustic and visual alarms**	**use of odorized CO^2 only with routine crew recognition training on the fragrance used**
Poland	**1**	1	1	1	1	1	0
Macedonia	**1**	0	0	0	0	1	1
Belgium	**0**	0	0	0	0	0	0
Austria	**2**	2	2	2	2	2	2
Total Observer Members (4)	**4**	**3**	**3**	**3**	**3**	**4**	**3**
Total Sum (20)	**35**	**28**	**28**	**23**	**24**	**22**	**9**

D 1.19 Check-Box (Part 2)

1.19) In case of fire, smoke constitutes a major problem on visibility, orientation, breathing capacity, etc. Therefore it is desirable to provide adequate means of combating while involving minimum risk to personnel. In this line please check which additional provisions you do foresee in your plants:

Regular Members	**plant ventilation system tested not to recirculate smoke in to the housing in case of fire**	**routine check of the generator housing and proper maintenance of openings, doors, etc.**	**others**	**all of the above**	**none of the above**	**Blank**	**N. Answ**
Australia	1	1	0	0	0	0	0
New Zealand	1	1	1	1	1	0	0
United Kingdom	0	0	0	0	0	0	1
Switzerland	2	2	0	2	0	0	0
Sweden	2	2	0	1	1	0	0
Norway	1	1	0	1	0	0	0

Canada	2	3	1	0	0	0	0
China	0	1	0	0	0	0	0
Spain	1	1	0	0	0	0	0
Russia	1	0	0	0	0	0	0
Japan	1	1	0	0	0	0	0
Germany	1	1	1	0	0	0	0
Brazil	2	5	2	1	0	0	0
United States	0	1	0	0	0	0	0
Mexico	1	1	0	0	0	0	0
France	0	0	0	0	0	0	1
Total Regular Members (16)	**16**	**21**	**5**	**6**	**2**	**0**	**2**
Observer Members	**plant ventilation system tested not to recirculate smoke in to the housing in case of fire**	**routine check of the generator housing and proper maintenance of openings, doors, etc.**	**others**	**all of the above**	**none of the above**	**Blank**	**N. Answ**
Poland	1	1	0	0	0	0	0
Macedonia	1	0	0	0	0	0	0
Belgium	0	0	0	0	0	0	1
Austria	2	2	1	1	0	0	0
Total Observer Members (4)	**4**	**3**	**1**	**1**	**0**	**0**	**1**
Total Sum(20)	**20**	**24**	**6**	**7**	**2**	**0**	**3**

[Back to Question]

D 1.19 Open question - 1

Question	Company	Result	
		Answer	Quant
others, please specify:	EMP005 (Switzerland)	Blank	0
	EMP006 (Switzerland)	Blank	0
	EMP008 (Brazil)	Blank	0
	EMP009 (Japan)	Blank	0
	EMP010 (Canada)	Blank	0
	EMP012 (Mexico)	Blank	0
	EMP013 (Brazil)	Blank	0
	EMP015 (New Zealand)	Blank	0
	EMP016 (Brazil)	Blank	0
	EMP019 (Sweden)	Blank	0
	EMP020 (Brazil)	Blank	0
	EMP021 (China)	Blank	0
	EMP023 (Spain)	Blank	0

EMP025 (Brazil)	Blank	0
EMP026 (Sweden)	Blank	0
EMP027 (Macedonia)	Blank	0
EMP028 (Japan)	Blank	0
EMP031 (Mexico)	Blank	0
EMP032 (Canada)	Manual fire fighting capabilities such as hose-cabinets and hose reel stations	1
EMP033 (New Zealand)	enhanced maintenance and testing to ensure the condition of generator fire protection components and system is maintained and the control and activation system operates correctly.	1
EMP036 (Canada)	Blank	0
EMP037 (Russia)	Blank	0
EMP038 (Sweden)	Blank	0
EMP039 (Australia)	Blank	0
EMP040 (Norway)	Blank	0
EMP043 (Japan)	Blank	0
EMP045 (Brazil)	Blank	0
EMP047 (Sweden)	Blank	0
EMP048 (Germany)	acoustic and visual alarms	1
EMP051 (Austria)	Blank	0
EMP053 (Poland)	Blank	0
EMP054 (Austria)	Blank	0
EMP055 (EUA)	Blank	0
EMP056 (Switzerland)	Blank	0
EMP058 (Brazil)	's housing	1

[Back to Question]

D 1.19 Open question - 2

Question	Company	Result	
		Answer	Quant
Comments on this issue:	EMP005 (Switzerland)	Blank	0
	EMP006 (Switzerland)	Blank	0
	EMP008 (Brazil)	Blank	0
	EMP009 (Japan)	Blank	0
	EMP010 (Canada)	Blank	0
	EMP012 (Mexico)	Implementar en el diseño de las casas de máquinas subterráneras la extracción del humo en la parte superior, en la bóbeda de la casa de máquinas. Las extracciones están en el nivel de los tableros	1
	EMP013 (Brazil)	Blank	0

	EMP015 (New Zealand)	Believe that the warning systems and training that are already in place cover the requirements. Generator fires are generally self extinguishing, and the company policy is that fire fighting is left to the professionals. There are regular trial evacuation and alarms and lighting are checked regularly. If staff are working in dangerous spaces where O2 levels could fall below life sustaining levels they are required to take an escape breathing kit with them.	1
	EMP016 (Brazil)	Blank	0
	EMP019 (Sweden)	Blank	0
	EMP020 (Brazil)	Blank	0
	EMP021 (China)	Special provisions are taken into accout as indicated dbove,the risk to personael will be reduced to a minimum.Any way,great attention should be paid.	1
	EMP023 (Spain)	Blank	0
	EMP025 (Brazil)	Blank	0
	EMP026 (Sweden)	Blank	0
	EMP027 (Macedonia)	Blank	0
	EMP028 (Japan)	The answer is based on manned power stations.	1
	EMP031 (Mexico)	implementar sistemas de monitoreo y control de sofocacion de incendios eficientes.	1
	EMP032 (Canada)	Blank	0
	EMP033 (New Zealand)	Maintenance & testing of older CO2 generator fire protection systems is often overlooked and carried out poorly. Consequently operators, maintainers and technical staff have little confidence that the CO2 systems would work properly when required.	1
	EMP036 (Canada)	In the past, when CO2 was in use, the signs indicated a warning. The indication here is just to share what was used when CO2 was used.	1
	EMP037 (Russia)	Blank	0
	EMP038 (Sweden)	Blank	0
	EMP039 (Australia)	Blank	0
	EMP040 (Norway)	Blank	0
	EMP043 (Japan)	Blank	0
	EMP045 (Brazil)	Blank	0
	EMP047 (Sweden)	Blank	0
	EMP048 (Germany)	Blank	0
	EMP051 (Austria)	Blank	0
	EMP053 (Poland)	Blank	0
	EMP054 (Austria)	Blank	0
	EMP055 (EUA)	Blank	0
	EMP056 (Switzerland)	Blank	0
	EMP058 (Brazil)	Blank	0

[Back to Question]

D 1.19.1 Check-Box

1.19.1) Additionally to these items the existence on an Emergency Plan, a Fire Brigade and Simulations are very actual, being so please answer the following items:						
Regular Members	**Answers**	**yes, our company has an Emergency Plan for Catastrophic Situations**	**yes, our company has a trained Fire Brigade**	**yes, we do perform fire hazard situation simulations**	**Blank**	**N. Answ**
Australia	**1**	1	1	1	0	0
New Zealand	**2**	1	1	1	1	0
United Kingdom	**0**	0	0	0	0	1
Switzerland	**3**	2	0	2	0	0
Sweden	**4**	4	1	1	0	0
Norway	**1**	1	1	1	0	0
Canada	**3**	3	2	2	0	0
China	**1**	1	1	1	0	0
Spain	**1**	1	1	1	0	0
Russia	**1**	1	1	1	0	0
Japan	**3**	2	1	2	0	0
Germany	**1**	1	0	1	0	0
Brazil	**7**	5	7	5	0	0
United States	**1**	1	0	1	0	0
Mexico	**2**	1	1	2	0	0
France	**0**	0	0	0	0	1
Total Regular Members (16)	**31**	**25**	**18**	**22**	**1**	**2**
Observer Members	**Answers**	**yes, our company has an Emergency Plan for Catastrophic Situations**	**yes, our company has a trained Fire Brigade**	**yes, we do perform fire hazard situation simulations**	**Blank**	**N. Answ**
Poland	**1**	1	0	1	0	0
Macedonia	**1**	0	0	0	0	0
Belgium	**0**	0	0	0	0	1
Austria	**2**	2	2	2	0	0
Total Observer Members (4)	**4**	**3**	**2**	**3**	**0**	**1**
Total Sum (20)	**35**	**28**	**20**	**25**	**1**	**3**

[Back to Question]

D 1.19.1 Open question - 1

Question	Company	Answer	Coding
yes, we do perform fire hazard situation simulations xx times a year.	EMP005 (Switzerland)	Blank	E
	EMP013 (Brazil)	Blank	E
	EMP051 (Austria)	Blank	E
	EMP009 (Japan)	Blank	E
	EMP037 (Russia)	Blank	E
	EMP006 (Switzerland)	Blank	E
	EMP015 (New Zealand)	Blank	E
	EMP019 (Sweden)	Blank	E
	EMP020 (Brazil)	Blank	E
	EMP021 (China)	Blank	E
	EMP027 (Macedonia)	Blank	E

	EMP025 (Brazil)	Blank	E
	EMP026 (Sweden)	Blank	E
	EMP039 (Australia)	Blank	E
	EMP036 (Canada)	Blank	E
	EMP038 (Sweden)	Blank	E
	EMP045 (Brazil)	Blank	E
	EMP047 (Sweden)	Blank	E
	EMP048 (Germany)	Blank	E
	EMP031 (Mexico)	Blank	E
	EMP043 (Japan)	1	A
	EMP008 (Brazil)	1	A
	EMP016 (Brazil)	1	A
	EMP023 (Spain)	1	A
	EMP054 (Austria)	1	A
	EMP056 (Switzerland)	1	A
	EMP033 (New Zealand)	3	C
	EMP028 (Japan)	one	A
	EMP010 (Canada)	one	A
	EMP053 (Poland)	one	A
	EMP040 (Norway)	some	D
	EMP058 (Brazil)	three	C
	EMP032 (Canada)	two	B
	EMP012 (Mexico)	una	A
	EMP055 (United States)	unknown	D

Summary

Grouping	Legend	Quantity
Grouping A	One (1) simulation a year	10
Grouping B	Two (2) simulation a year	1
Grouping C	Three (3) simulation a year	2
Grouping D	Unknown	2
Grouping E	Blank	20
Total of answered questions		**35**

[Back to Question]

D 1.19.1 Open question - 2

Question	Company	Answer	Coding
Comments on this issue:	EMP005 (Switzerland)	Blank	F
	EMP006 (Switzerland)	Blank	F
	EMP008 (Brazil)	Blank	F
	EMP009 (Japan)	Blank	F
	EMP010 (Canada)	Blank	F
	EMP012 (Mexico)	Blank	F
	EMP013 (Brazil)	Blank	F
	EMP015 (New Zealand)	Blank	F
	EMP016 (Brazil)	Blank	F
	EMP019 (Sweden)	Blank	F
	EMP020 (Brazil)	Blank	F
	EMP021 (China)	Special measures and training should be taken,especially for the emergency conditions.	C
	EMP023 (Spain)	Included on emergency plans of the installations.	E
	EMP025 (Brazil)	Blank	F
	EMP026 (Sweden)	Blank	F
	EMP027 (Macedonia)	Blank	F
	EMP028 (Japan)	Blank	F
	EMP031 (Mexico)	Blank	F

	EMP032 (Canada)	Blank	F
	EMP033 (New Zealand)	Involving fire fighting personnel in regular familiarizations of fire protection equipment and undertake fire drills / simulations is an important aspect to ensure appropriate understanding of equipment and fire fighting procedures.	B
	EMP036 (Canada)	Blank	F
	EMP037 (Russia)	Blank	F
	EMP038 (Sweden)	Frequent education/training on general fire fighting, no specific education/training on fire in generators. Rescue personel have training in the power plant.	B
	EMP039 (Australia)	Blank	F
	EMP040 (Norway)	some = once a year per region	E
	EMP043 (Japan)	Blank	F
	EMP045 (Brazil)	There are trained Fire Brigade to this cases and also internal commissions, to prevent accidents in general (including fire).	A
	EMP047 (Sweden)	Blank	F
	EMP048 (Germany)	fire simulation one times in two years with staff and fire brigade	A
	EMP051 (Austria)	Blank	F
	EMP053 (Poland)	The Company relies on state-owned Fire Brigade	D
	EMP054 (Austria)	Blank	F
	EMP055 (United States)	Training for all hazards, not just fire hazards	C
	EMP056 (Switzerland)	in Zusammenarbeit mit der öffentlichen Feuerwehr	B
	EMP058 (Brazil)	Blank	F

Summary

Grouping	Legend	Quantity
Grouping A	Focus on internal trainings with staff and fire internal brigade	2
Grouping B	Focus on trainings and collaboration with public Firemen	3
Grouping C	Focus on training on emergency conditions, not only fire	2
Grouping D	Responsibility transfered to official Firemen (state owned)	1
Grouping E	Other aspects.	2
Grouping F	Blank	25
Total of answered questions		**35**

[Back to Question]

D 1.20 Check-Box

1.20) Considering the existence of the recently launched standards (for instance NFPA 851), is there a need of any additional specific international standard on generator fire protection?

Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	**1**	1	0	0	0
New Zealand	**2**	1	1	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	0	3	0	0
Sweden	**4**	2	0	2	0
Norway	**1**	0	1	0	0
Canada	**3**	1	1	1	0
China	**1**	1	0	0	0
Spain	**1**	0	1	0	0
Russia	**1**	0	1	0	0
Japan	**3**	0	2	1	0
Germany	**1**	0	1	0	0
Brazil	**7**	1	4	2	0
United States	**1**	0	1	0	0
Mexico	**2**	0	1	1	0
France	**0**	0	0	0	1

Total Regular Members (16)	31	7	17	7	2
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	0	1	0
Macedonia	**1**	0	0	1	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	1	1	0
Total Observer Members (4)	**4**	**0**	**1**	**3**	**1**
Total Sum (20)	**35**	**7**	**18**	**10**	**3**

[Back to Question]

D 1.20 Open question

Question	Company	Answer	Coding
Any additional comment? Please state here:	EMP005 (Switzerland)	Blank	H
	EMP006 (Switzerland)	Blank	H
	EMP008 (Brazil)	Blank	H
	EMP009 (Japan)	Blank	H
	EMP010 (Canada)	Blank	H
	EMP012 (Mexico)	Blank	H
	EMP013 (Brazil)	Não ainda. O primeiro passo está sendo dado que é criar um forum para discussão das vantagens, desvantagens, aspectos econômicos, manutenção e operação sobre adoção de sistema de exitinção de fogo dentro dos compartimentos de hidrogeradores.	B
	EMP015 (New Zealand)	Personally don't believe that generator fire protection as distinct from fire detection is really necessary	F
	EMP016 (Brazil)	Blank	H
	EMP019 (Sweden)	Blank	H
	EMP020 (Brazil)	Blank	H
	EMP021 (China)	We propose to organize a special meeting for discussion this topic,or as a routine,this subject will be discussed in the generator group meeting in CIGRE annual meeting.	D
	EMP023 (Spain)	Blank	H
	EMP025 (Brazil)	Blank	H
	EMP026 (Sweden)	Blank	H
	EMP027 (Macedonia)	we can not comment due to missing standard in the company	E
	EMP028 (Japan)	No idea	E
	EMP031 (Mexico)	Blank	H
	EMP032 (Canada)	FM Global and IECTC	G
	EMP033 (New Zealand)	published guidelines would be very useful that recommended suitable generator fire protection schemes based on generator design aspects and generator enclosure design aspects.	A
	EMP036 (Canada)	Not familiar with that standard	E
	EMP037 (Russia)	Blank	H
	EMP038 (Sweden)	Blank	H
	EMP039 (Australia)	We felt that it is a high level document and not descriptive enough to make decisions. Our fire protection decisions are based on risk (safety, finance, legal, environmental, community standing etc). We have to make decisions on a)whether to have a fire protection or not, b) if fir protection is needed should it be automatic or manual triggering, c) if automatic what should be the triggers, d) guide lines for selecting extinguishing materials etc.	C
	EMP040 (Norway)	Blank	H
	EMP043 (Japan)	Blank	H
	EMP045 (Brazil)	Blank	H
	EMP047 (Sweden)	High pressure water mist	G
	EMP048 (Germany)	Blank	H

	EMP051 (Austria)	Blank	H
	EMP053 (Poland)	Not considered	E
	EMP054 (Austria)	Blank	H
	EMP055 (United States)	Blank	H
	EMP056 (Switzerland)	Blank	H
	EMP058 (Brazil)	Blank	H

Summary

Grouping	Legend	Quantity
Grouping A	Published guidelines would be very useful	1
Grouping B	Not yet, the subject has to be discussed in a forum	1
Grouping C	The NFPA 851 Standard is not descriptive enough	1
Grouping D	This subject should be discussed in a special CIGRÉ meeting	1
Grouping E	Not familiar with the indicated standard, has no idea or not considered.	4
Grouping F	Believe that GFP is not necessary	1
Grouping G	Answer does not match the subject asked	2
Grouping H	Blank	24
Total of answered questions		**35**

[Back to Question]

D 1.21 Check-Box

1.21) According to your opinion, is there any question that is missing in this part of the questionnaire?					
Regular Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Australia	**1**	0	1	0	0
New Zealand	**2**	0	2	0	0
United Kingdom	**0**	0	0	0	1
Switzerland	**3**	0	3	0	0
Sweden	**4**	0	2	2	0
Norway	**1**	0	1	0	0
Canada	**3**	0	2	1	0
China	**1**	0	1	0	0
Spain	**1**	0	1	0	0
Russia	**1**	0	1	0	0
Japan	**3**	0	3	0	0
Germany	**1**	0	1	0	0
Brazil	**7**	2	3	2	0
United States	**1**	0	1	0	0
Mexico	**2**	0	2	0	0
France	**0**	0	0	0	1
Total Regular Members (16)	**31**	**2**	**24**	**5**	**2**
Observer Members	**Answers**	**Yes**	**No**	**Blank**	**N. Answ**
Poland	**1**	0	1	0	0
Macedonia	**1**	0	1	0	0
Belgium	**0**	0	0	0	1
Austria	**2**	0	1	1	0
Total Observer Members (4)	**4**	**0**	**3**	**1**	**1**
Total Sum (20)	**35**	**2**	**27**	**6**	**3**

[Back to Question]

D 1.21 Open question

Question	Company	Result	
If yes, please state it here:	EMP005 (Switzerland)	Blank	0
	EMP006 (Switzerland)	Blank	0

	EMP008 (Brazil)	Blank	0
	EMP009 (Japan)	Blank	0
	EMP010 (Canada)	Blank	0
	EMP012 (Mexico)	Blank	0
	EMP013 (Brazil)	Para as empresas que adotam "GFP" deveriam ser questionado mais a polítcade manutenção e renovação desses sistemas.	1
	EMP015 (New Zealand)	Blank	0
	EMP016 (Brazil)	According to your opinion, is absolutely necessary to install a fire extinguishing system in large hydrogenerators? (Yes or No) If yes, please specify here why: If no, please specify here why:	1
	EMP019 (Sweden)	Blank	0
	EMP020 (Brazil)	Blank	0
	EMP021 (China)	Blank	0
	EMP023 (Spain)	Blank	0
	EMP025 (Brazil)	Blank	0
	EMP026 (Sweden)	Blank	0
	EMP027 (Macedonia)	Blank	0
	EMP028 (Japan)	Blank	0
	EMP031 (Mexico)	Blank	0
	EMP032 (Canada)	Blank	0
	EMP033 (New Zealand)	Blank	0
	EMP036 (Canada)	Blank	0
	EMP037 (Russia)	Blank	0
	EMP038 (Sweden)	Blank	0
	EMP039 (Australia)	Blank	0
	EMP040 (Norway)	Blank	0
	EMP043 (Japan)	Blank	0
	EMP045 (Brazil)	Blank	0
	EMP047 (Sweden)	Blank	0
	EMP048 (Germany)	Blank	0
	EMP051 (Austria)	Blank	0
	EMP053 (Poland)	Blank	0
	EMP054 (Austria)	Blank	0
	EMP055 (EUA)	Blank	0
	EMP056 (Switzerland)	Blank	0
	EMP058 (Brazil)	Blank	0

[Back to Question]

I, as the Convener and executor of this task, am at your disposal via the e-mail a.gromow@gromow.com or per cellular phone [+5511 8223-7511 or +5511 9659-0846] or per Skype – agromow - [although the indication is off please try – I may be on line].

Alexander Gromow
São Paulo/SP
Brazil
August, the 20th, 2009.