



**INITIAL DRAFT OF THE QUESTIONNAIRE REPORT ON
HYDROGENERATORS FIRE PROTECTION UPDATE
(September 2008)**

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A - INTRODUCTION:

As decided by the A1.2 Study Committee during the meeting held in Lausanne in 2005 the former survey made in 1981 by Dr. R.D. Kranz (published in 1985 by the Nr. 103 of Electra under the name of "Fire extinguishing in large salient pole machines¹") should be updated with emphasis to hydro generators.

The present work is this UPDATE made respecting the initial work but enlarging the survey field to correlated areas in order to open new possibilities of experience gathering. The initial work was based upon one sole questionnaire that in the present UPDATE was enlarged and divided in 6 parts as follows:

1	Generator user (owner)
2	Generator Manufacturer
3	Insurance Company, Reinsurance Company or Insurance Broker
4	Erection, Commissioning, Refurbishment, Maintenance.
5	Research Centers and Universities
6	Consulting Companies

As an initial comment the UPDATE showed that in the last 27 years many basic aspects related to the Generator Fire Protection are still the same and the following sentence stated by Dr. Kranz is still actual: "***With the absence of international standards or recommendations the philosophy for application of fire extinguishing installations varies considerably.***" The link that bound many of the answers received and that constitutes almost an internationally recognized and applied standards are the NFPA Standards.

The present survey also prolonged the validity of Dr. Kranz conclusions with regard to "***The decisions are mostly taken individually based on own positive or negative experience, tradition or request of law and insurance companies respectively.***" But here some new tendencies based upon the time of use of the material that in 1981 were still new in the market show some new tendencies as the answers did show. Although there may be some indications that some of the decisions related to the use or not of fire protection equipment that are being adopted should be subject of a deeper risk assessment considering all involved elements of an eventual fire accident.

In general it is possible to the readers to draw their own comparison conclusions in detail questions since reference to the original work is provided.

B – METHODOLOGY:

Following to the CIGRÉ's tradition as it was informed to this Convener the data for this work was collected by means of a questionnaire² in English written in MS Word. Here the language barrier problem was clearly detected; this shows the necessity of improvement in the communications area. The Convener in this case did communicate with many fellow colleagues in several languages in order to offer support as far as possible the understanding.

This particular questionnaire did deal with a specific subject and the Convener stated his clear willingness to support the understanding of the questions, but very few questions

asking for explanations were made what lead to the necessity to an additional round of clarifications that will be detailed further on.

An Internet based Working Page was established to support the distributions of the questionnaire and related documents and later on to collect all received answer in a completely transparent work that could and can be followed by the involved parties. The address of this page is: <http://www.gromow.com/CIGRE/working-page.htm> . Some of the documents references that will be made later on will relay to this Internet page.

The task of addressing the A1-Regular Members and A1-Observer Members, indicated by the secretary Mr. Reinhard Joho, was delegated by the A1.02 Group Coordinator Mr. Remi Tremblay to the WG A1.02-03 Convener Mr. Gromow . The work should be done by the Regular and Observer Members on a pyramid principle; it means each one of them received a personalized letter with information and the questionnaire to be distributed to their national contacts.

The final statistics answers received from 19 countries, per group and per country reaching the total of 65 individual group sections answered can be seen on the table bellow:

	Statistics						
	Number of fulfilled Questionnaires						
	Legend on answered Groups: (1)-Owner (2)-Manufacturer (3)-Insurance &... (4)-Maintenance &... (5)-Universities &... (6)-Consulting						
	1	2	3	4	5	6	total
A1 REGULAR MEMBERS							
Australia + New Zealand	3		1	2			6
United Kingdom						2	2
Switzerland	3	1				1	5
Sweden	4		1			3	8
Norway	1	1	1			1	4
Canada	3	1					4
China	1	1	1	1		1	5
Spain	1						1
Russia	1						1
Japan	3	2			1		6
Germany	1		1			1	3
Brazil	7	1		1			9
USA	1	1					2
Mexico	2						2
France		1					1
A1 OBSERVER MEMBERS							
Poland	1						1
Macedonia	1						1
Belgium					1		1
Austria	2	1					3
Total of 20 Countries participated	35	10	5	4	2	9	65

All Regular and Observer Members from the 35 countries indicated by the secretary Mr. Joho were addressed individually with a dedicated package of information and documents related on how to understand this particular survey and how to motivate the national fellow members³, and follow up was made on all of them. As indicated in the table answers were received from 20 countries. As a matter of fact the convener suggests the Group A1 to review the list of Regular and Observer Members since there are many countries that could be added to the list received and this can be interesting for future works of this group.

Eight (8) Regular Members did either not answer at all, not get any answer from their fellow members or simply decided not to participate; these countries are: South Africa, Italy, Korea, India, Finland, Serbia & Montenegro, Argentina and Romania. In addition to that the Malaysian address did not respond.

In the case of the Observer members four (4) did not collaborate: Algeria, Venezuela, Egypt and Croatia. The Libyan address did not work. Israel did participate in the questionnaire preparation phase with a significant collaboration but could not send any answer because there is no hydropower station in that country.

Efforts were made to spot the Malaysian and Libyan representatives without success. A complete situation of the participation and receipt of answers was always given by means of a table available at the Internet Working Page⁴.

It is to point out that the suggested working scheme did depend upon the support of the Regular and Observer Members to get answers specifically to the groups:

3	Insurance Company, Reinsurance Company or Insurance Broker
4	Erection, Commissioning, Refurbishment, Maintenance.
5	Research Centers and Universities

Since these groups usually are not CIGRÉ members, in a certain way this applies also to the group:

6	Consulting Companies
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For these groups a special action of address survey and contact action was required. Working schemes and letter models for this action were provided by the Convener. But the result show that a reasonable success rate of this initiative was not achieved, being so the group 5 Research Centers and Universities does not show any useful result and cannot be considered. The statistic shows the performance of each involved countries.

Here we call the attention to the fact of the responsibility involved in the motivational effort to be made by the Convener in such a work involving several countries, different languages and philosophies. The *A1 Study Committee Secretary* Mr. Reinhard Joho approached this issue with the following sentence: ***“We should always keep in mind that the National Members (and Observer Members) are responsible for answers”***, and on the top of that all possible support was given in this case, as well as additional support was offered.

C – Individual item analysis: the survey made through the questionnaires divided in six groups allowed in some cases interesting comparative analysis from similar aspects seen by different groups. Other questions were made for specific groups and will be considered separately.

Generator Fire Protection is a very specific subject and the equalization of the answers required a special effort. In some cases the equalization was started as soon as the answers were received, but during the compilation of the statistical values a second round of equalization questions was required. Only 8 out of 36 of the sent questions were not answered by the involved parties, in spite of several requests sent to each one of the involved colleagues, as can be seen at the table below:

No.	Question to	sent on	answer on
1	Austrália - Snowy Hydro Limited	25/03/08	27/03/08
2	Austria-Verbund AHP (Austrian Hydro Power)	24/03/08	07/04/08
3	Austria-Vorarlberger Illwerke AG	24/03/08	
4	Brazil-Copel Geração SA	24/03/08	09/04/08
5	Brazil-FURNAS CENTRAIS ELÉTRICAS	22/01/08	11/04/08
6	Brazil-Itaipu	25/03/08	17/04/08
7	Brazil-Tractebel	26/02/08	30/03/08
8	Canada-Churchill Falls (Lab.) Corporation	25/03/08	01/04/08
9	Canada-Manitoba Hydro	02/10/07	09/10/07
10	Canada-Ontario Power Generation	18/09/07	21/09/07
11	China-Harbin-Consulting	25/03/08	
12	France-Alstom	26/03/08	27/03/08
13	Germany-Vattenfall Europe Generation	24/03/08	04/04/08
14	Japan-Kansai Electric Power Company	27/03/08	06/04/08
15	Macedonia-JSC ELEM - HPP MAVROVO	21/02/08	26/02/08
16	Mexico-Comisión Federal de Electricidad	27/03/08	
17	Mexico-Luz y Fuerza del Centro	27/03/08	
18	New Zealand-Contact Energy Limited (Hydro)	28/03/08	06/04/08
19	New Zealand-Meridian Energy Limited	29/03/08	31/03/08
20	Norway-Alstom Vannkraft AS	28/03/08	18/04/08
21	Norway-SWECO Grøner	28/03/08	09/04/08
22	Poland-Hydraulic Power Plant Zarnowiec	30/03/08	
23	Spain-Iberdrola	25/03/08	23/04/08
24	Sweden-Fortum Generation AB	30/03/08	16/05/08
25	Sweden-Jämtkraft AB	30/03/08	
26	Sweden-SWECO [PDF]	30/03/08	07/04/08
27	Sweden-SWECO [Word]	30/03/08	
28	Sweden-Vattenfall AB Vattenkraft-Sweden	30/03/08	11/05/08
29	Switzerland-ALSTOM-Birr	31/03/08	
30	Switzerland-Atel AG	05/01/08	07/01/08
31	Switzerland-BKW FMB Energie AG	31/03/08	16/04/08
32	Switzerland-Colenco Power Engineering	31/03/08	03/04/08
33	Switzerland-Nordostschweizerische Kraftwerke Baden	07/03/08	12/03/08
34	USA-U.S. Army Corps of Engineers, Hydroelectric Design Center	12/02/08	15/02/08
35	USA-via NZ- Factory Mutual - Anterior	23/09/07	24/10/07

C.1 – Items that allow a comparative analysis: The following items were picked up out of several groups. The original questions can be seen on the particular group sections and are available for consultation.

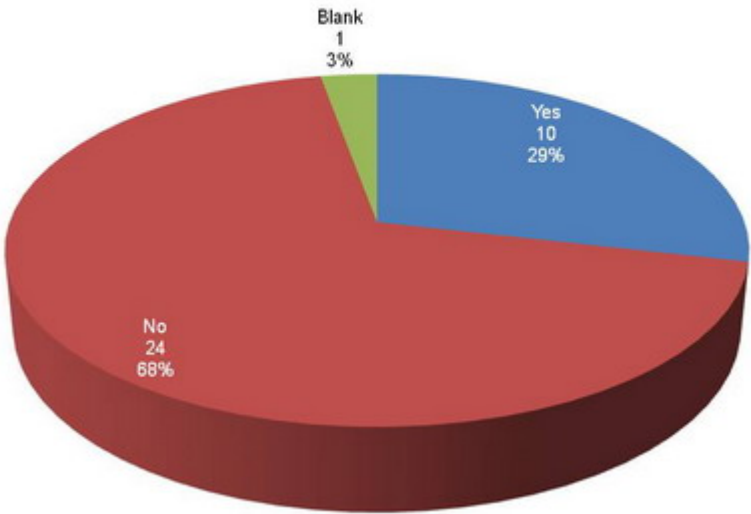
C.1.1 – Question about the existence of standards recommending generator fire protection (GFP) in the specific country in which the questionnaire was answered:

This question was answered by the Group 1 Users and Group 6 Consultants; and there was a control question regarding the Group 2 Manufactures. Here the original questionnaire's questions were used to make the comparison.

Observation: 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.

C.1.1.1- The Group 1 Users composed by 35 answers' can be seen in the following graphic (the corresponding questionnaires and the resulting statistical tables are available in the corresponding annexes):

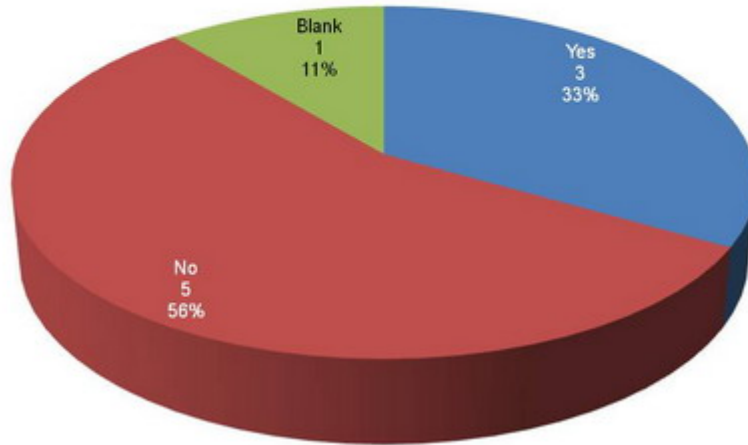
1.1) Are there standards recommending generator fire protection (GFP) in your country?



NOTE: the numbering of the tables and graphics that illustrate this work do correspond to the original numbering of the original Questionnaire (although during the issue of the statistics some adjustments in some item original item numbers had to be made a correlation table is provided in the annex⁵). On the other hand the alpha-numeric numbering used in the present work is fully independent from the questionnaire.

C.1.1.2-The Group 6 - Consulting Companies were also asked about the existence of standards in their countries and for the group of 9 companies resulted the following graphic:

6.5) Are there standards recommending generator fire protection in your country?



C.1.1.3- On the other hand a control question was made to the members of the Group 2 – Manufactures asking them which standards they usually apply in the design of fire protection for their generators and we got the following table:

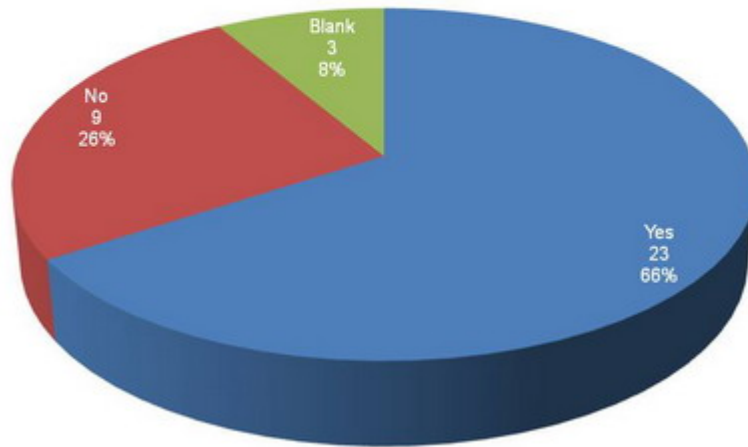
NFPA (USA)	6
Depends upon customer's requirements	2
Own local standards	1
Not applicable	1

Conclusion: There are still no national standards in great quantity and the NFPA are unanimously accepted almost everywhere.

C.1.2 – The basic question about the recommendation of the installation of Generator Fire Protection, starting with the direct YES or NO questions stated to several groups:

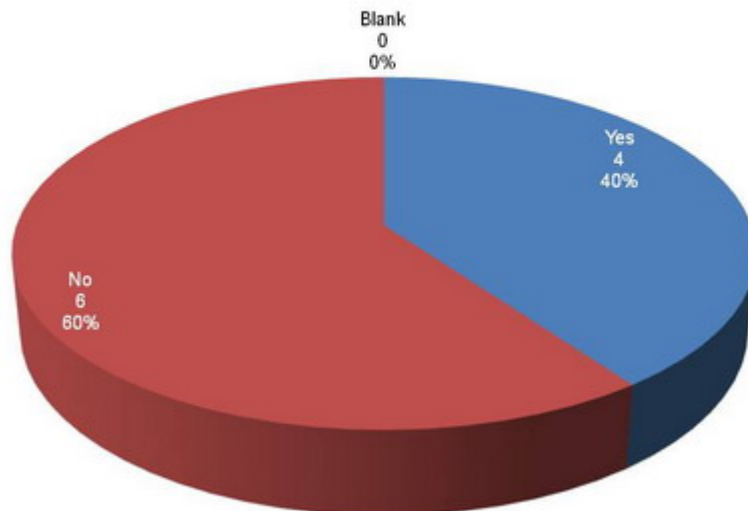
C.1.2.1 – For the Group 1 - Users the answers can be seen tin the following graphic:

1.2) Do you recommend or install generator fire protection?



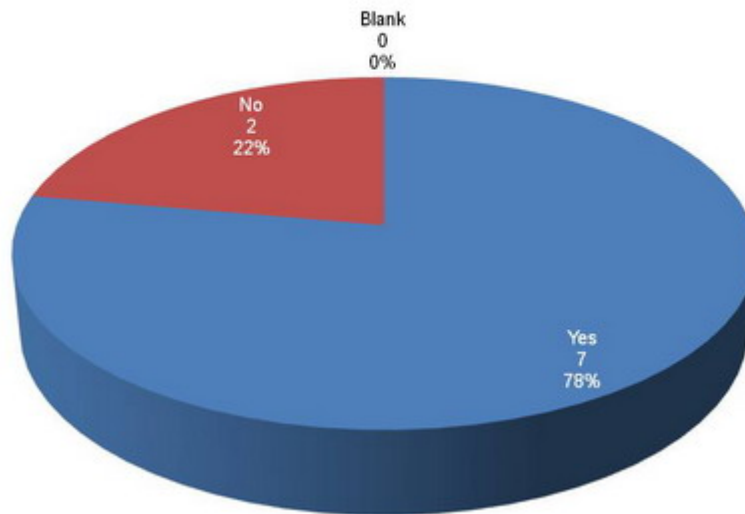
C.1.2.2 – On the other hand the Group 2 – Manufacturers mainly based upon the new insulating materials, but possibly assuming a responsibility bigger then necessary for the unit as a whole, considering the equipment after some years of use, show the following answers:

2.1) From the generator manufacturer's standpoint, do you recommend the use of Generator Fire Protection?



C.1.2.3 – And the Group – 6 Consultants has the following opinion:

6.10) In your opinion is a Generator Fire Protection installation required nowadays?



These are the first answers to this complex question, this first approach shows that nowadays the users and consulting companies that sent answers do recommend the use of GFP, and the manufacturers don't – but is this a true picture?

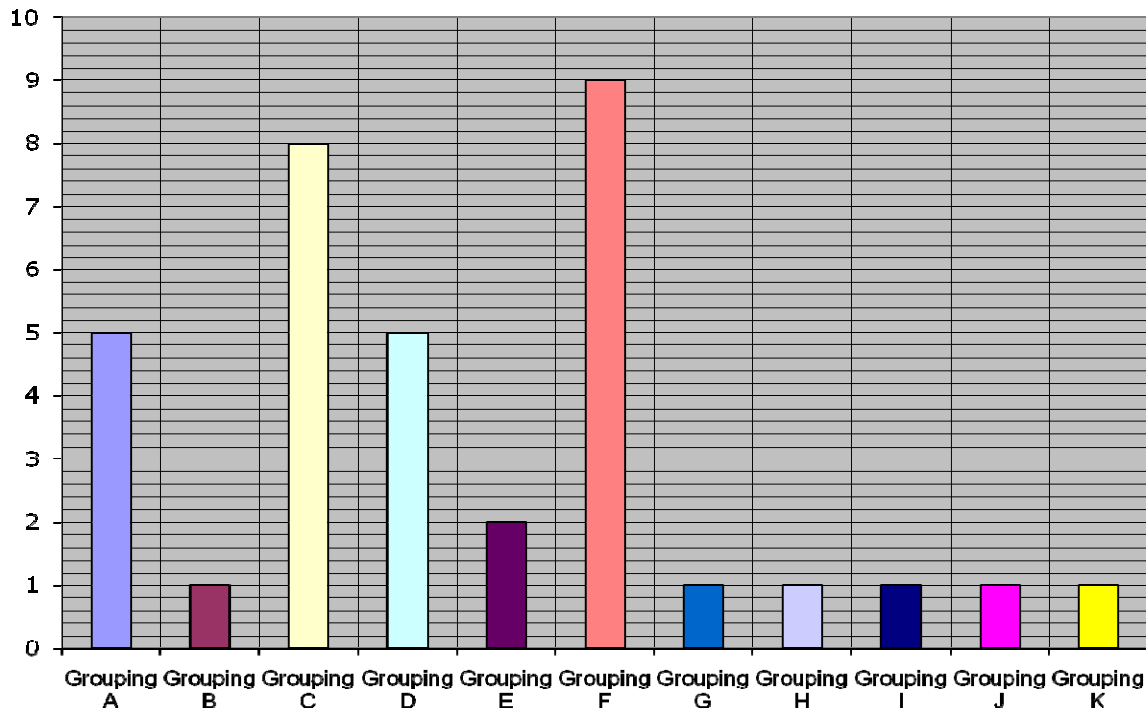
C.1.3 – The basic question about the recommendation of the installation of Generator Fire Protection, now analysed through control descriptive questions;

An 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 (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).

C.1.3.1 –The first question was made to the Group 1 – Users about the reasons that lead them to answer that way, here are they answers already grouped in order to allow a statistical analysis, the isolated statements can be seen in the corresponding annexes. Here the graphic:

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	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 we see that 8 do not install but the Groupings A+D+F=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.

C.1.3.2 –The Group 2 – Manufacturers in general is strongly relying on the no flammability characteristics of the insulation material used nowadays, but the machine should be considered not only constituted by insulation material and not always in pristine absolutely like new conditions, as the reality of some power plants clearly show.

Two control questions were made based upon the question if a Manufacturer recommends the use of GFP or not and this was detailed as follows:

2.1.1) If yes, which type?

Grouping	Legend	Quantity
Grouping A	CO2	2
Grouping B	Europe INERGEN & Asia water or CO2	1
Grouping C	Water spray for big machines	1
Grouping D	Did not answer	6

C.1.3.3–This statistics covers the first one since the Grouping D – not answered – is the majority; but there is one answer that is the Grouping B that shows the tendency of the use of Inergen in Europe and less restrictive conditions in other parts of the world. An interesting aspect to be considered.

C.1.3.3.1 – The answer in case of a negative:

2.1.2) If not, please state your reasons.

Grouping	Legend	Quantity
Grouping A	No tradition to use GFP	1
Grouping B	No need due to the use of non flammable insulating material	3

Grouping C	It's a matter between customer and insurance company	1
Grouping D	GFP is standard equipment	1
Grouping E	Did not answer	4

Here the Grouping B – “No need due to the use of non flammable insulating material” shows the lead but again 4 Manufacturers did prefer not to comment on this item.

C.1.3.3.2 – In order to close the analysis of this question and considering the fact that we have the opinion of the Group 6 – Consulting Companies the following closed question comments were requested and the answers were the following:

6.10) Do you have any comment on this issue you would share with us?

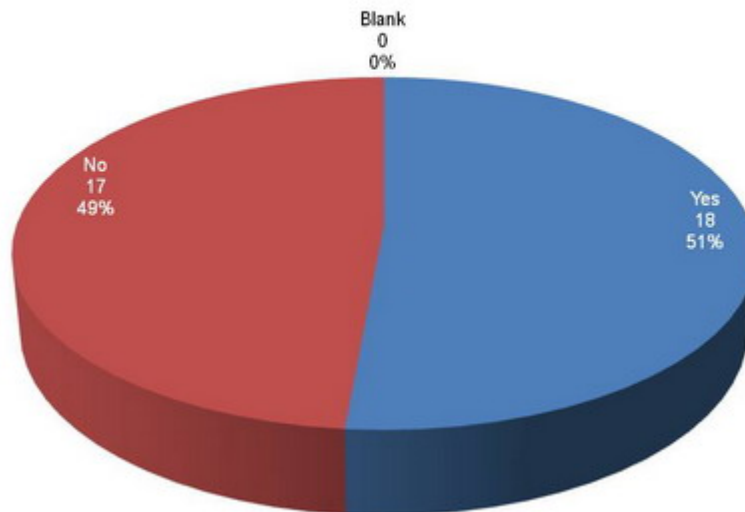
Grouping	Legend	Quantity
Grouping A	Only for big machines	1
Grouping B	Only for older type generators (old insulation types)	1
Grouping C	Did not answer	7

Here the consulting did not use the given opportunity to issue major comments on this aspect.

C.2 – Recalling a question made in the original work 27 years ago about “Difference between the present and the past fire protection strategies” we had the opportunity to collect closed answers from the following Groups:

C.2.1 – First the Group 1 – Users:

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



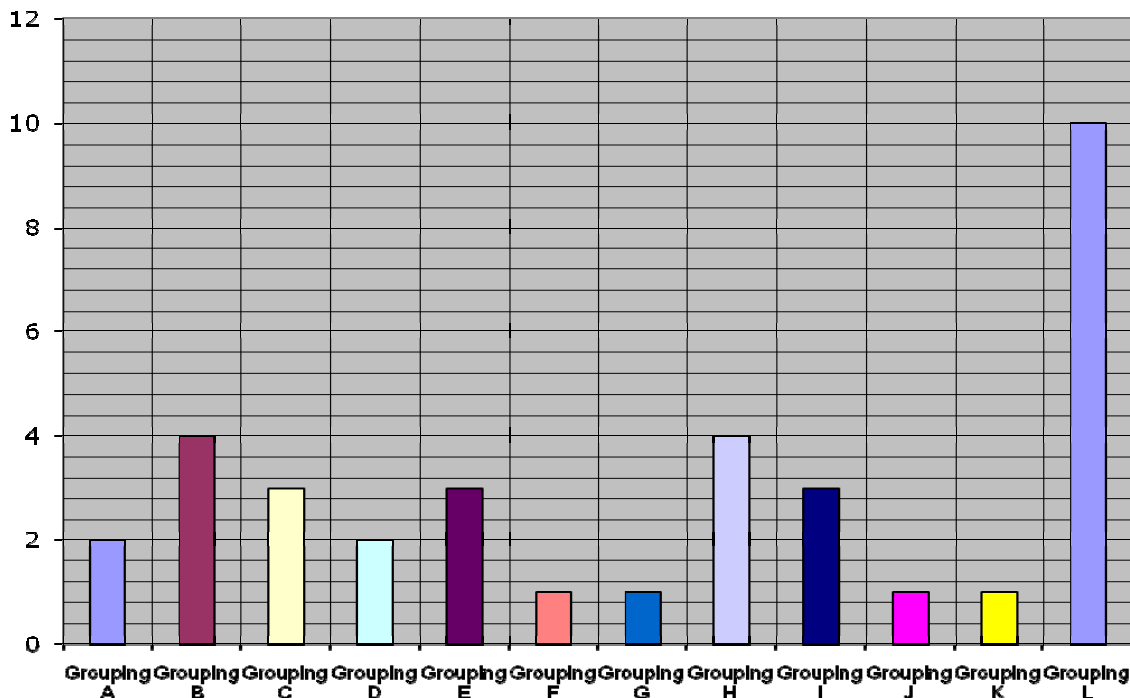
For the Users the outcome is even in these cases.

Still for the Users two additional questions were made in order to explore this item more.

C.2.1.1 – One for the case that a change happened:

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	1
Grouping L	Did not answer	10



The Grouping H calls for the dependency to the insulation type, the same criteria was mentioned by the Grouping B but already calling for removal of the installed GFP and other significative groups call for the installation of water, measures to improve availability and effectiveness and focus on man security and environment. The detailed answers show interesting contributions to this aspect, although the relatively high number of colleagues that did not answer to this exploratory question.

C.2.1.2 – The other asked for the reasons of changes to be made:

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

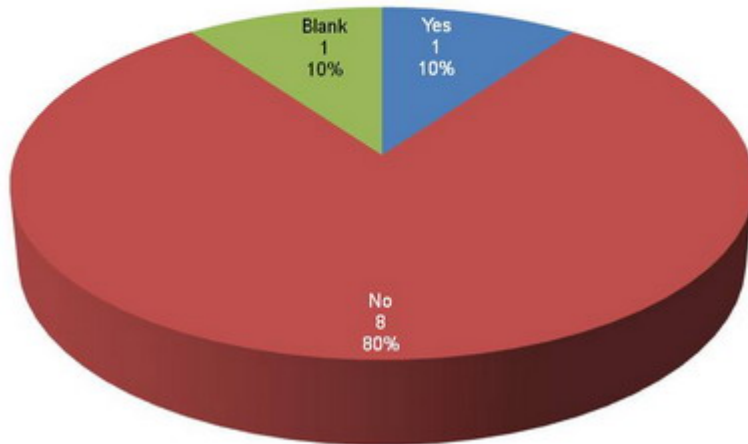
Grouping	Legend	Quantity
Grouping A	No, no changes	20
Grouping B	Installing water + VESDA	1
Grouping C	Studying the elimination of GFP for small and medium units	1
Grouping D	Changing insulation and removing GFP	2
Grouping E	Depends of machine type	1
Grouping F	Removal of CO2	1
Grouping G	Not applicable	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 were planned.

C.2.2 – Now let's see how the Group 2 – Manufactures see this question nowadays:

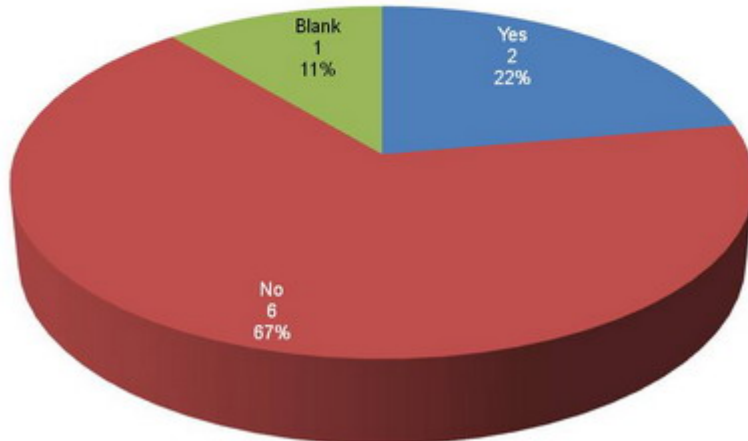
2.2.1) Any change towards the former trend?



From the Manufactures' stand point although new materials that 27 years ago were still a novelty are now gaining more operational experience there was clearly no trend change.

C.2.3 – For the Group 6 – Consulting Companies we have:

6.4.1) Do you recognize any change towards the former trend (status quo) in fire protection systems your country?



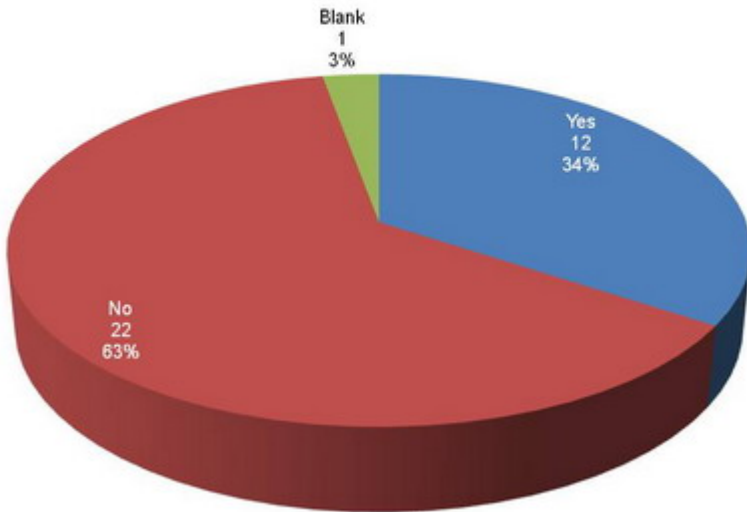
A similar statement as that of the Manufacturers.

Comparing with the first work and considering that no Groups differentiation was made then we can conclude that nowadays the alternative “no trend change” is a clear winner and in Dr. Kranz’s work we had a clear “7 to 7 even”.

C.3 - Another criteria that could be surveyed in several groups was the most used protection systems:

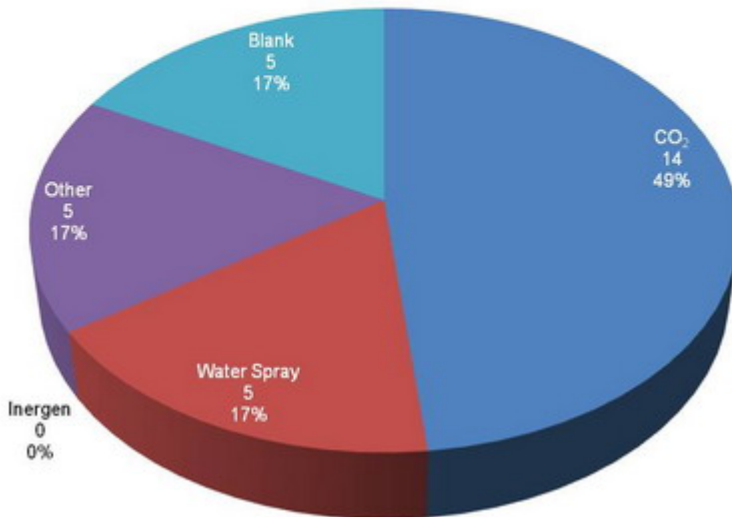
C.3.1.1 - For the Group 1 – Users a composed question was made this resulting in three analysis as follows:

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



C.3.1.2 - This question opened the field to explore the answers No and Yes as the following graphics summarize:

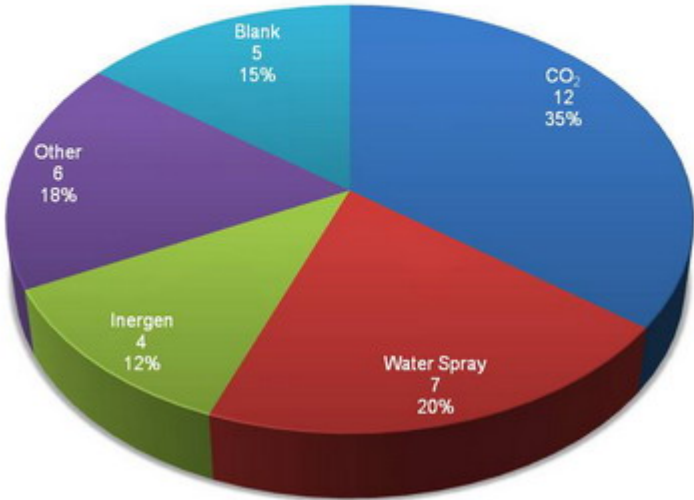
1.6.1) If no, please indicate which is your sole fire protection system:



Here we have clear CO₂ majority.

C.3.1.3 – The las analysis of this item:

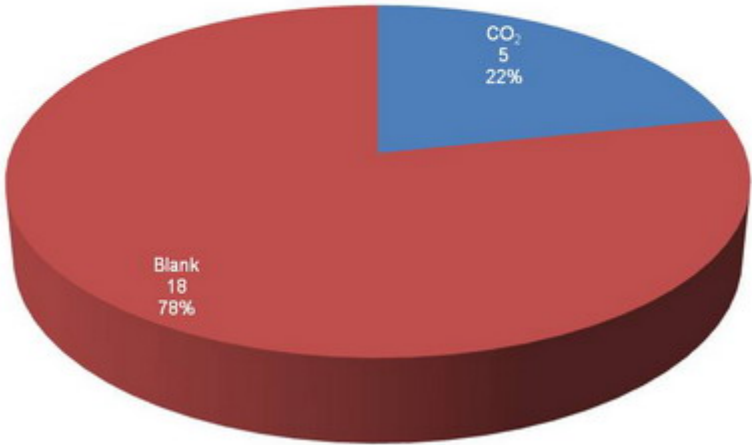
1.6.2) If yes, please indicate which are you're the different fire protection systems you have installed:



CO₂ continues in the first place but it is interesting to mention the presence of the clean agent INERGEN[®] that is already standard in some European countries.

C.3.2 - The view of the Group 2 - Manufacturers members is somewhat different as the graphic shows:

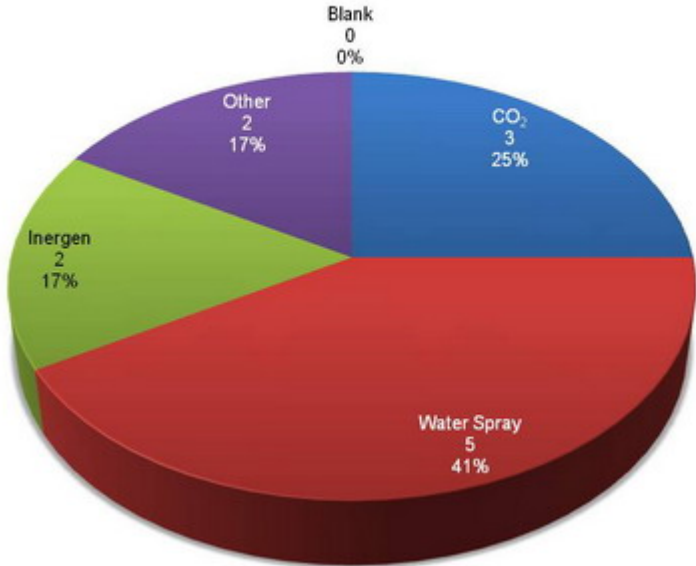
2.2) From your experience, which is the type of generator fire extinguishing method more frequently used nowadays?



The majority did not answer this is in line with the question related to the new insulation materials that will be approached later on.

C.3.3 - In this case we also had the opportunity to check the opinion of the Group 6 – Consulting Companies as follows:

6.4) From your experience, which is the type of generator fire extinguishing method more frequently used nowadays?



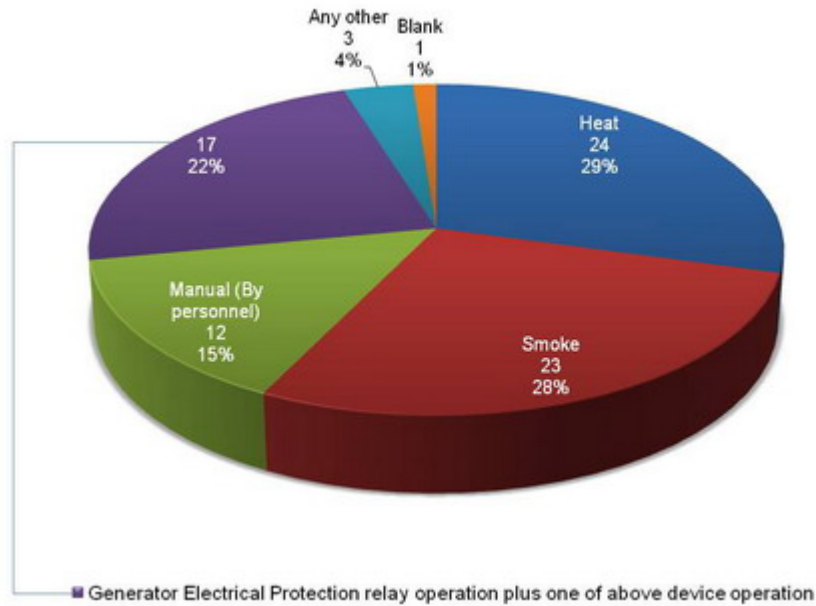
The Consulting Companies see a progress in the water spray use and also register the use of INERGEN besides CO₂.

The advance of the use of clean agents as INERGEN is following not only the safety standards as well as materializing the act of acquiring knowledge about environmental concerns also in the field of fire protection now specifically for hydro generators. This is a clear differential when comparing the former stage and the present GFP tendencies.

C.4 - The way fire is detected is also a question that was stated to three groups and the corresponding answers are the following:

C.4.1 - The Group 1 – Users that have to live with the equipment and bears the responsibility of supplying steady power informed:

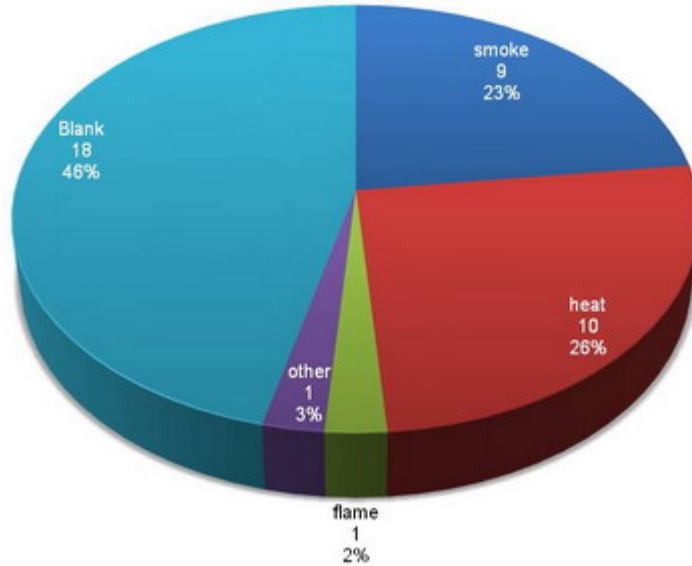
1.10) How is the fire detected in your generators? Please tick the box.



This chart was made based upon a multi alternatives check-box question type that can be seen in the original answered questionnaires.

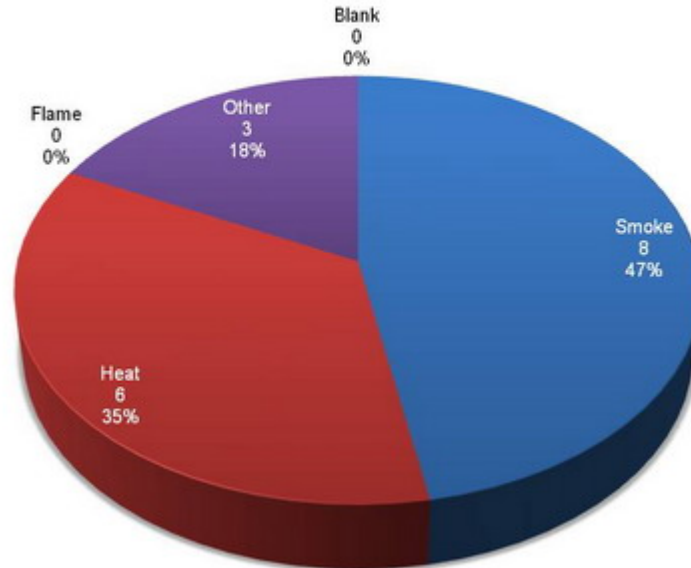
C.4.2 - The Group 2 – Manufacturers dis show the following answers:

2.4) What is the state of the art in the detection in accordance to your experience?



C.4.3 - The Group 6 – Consulting Companies commented the following about the present detection status:

6.5.4) What is the state of the art in the detection in accordance to your experience?



As a matter of fact there is no big change when compared with the situation 27 years ago what the types of detectors is concerned, but as the work will show there are some improvements in the execution of, for instance smoke detector where the use of sophisticated equipments like VESDA⁷ is gaining terrain.

A deeper consideration was made by stating an open question to Manufacturers and to consulting Companies searching for more details on tendencies and recommendations, here the answers:

C.4.2.1 - At first what the Group 2 – Manufacturers say:

2.4.1) Which are the types of detection devices you normally use and/or recommend?

Grouping	Legend	Quantity
Grouping A	Combined smoke and heat	7
Grouping B	Heat	2
Grouping C	Manufacturer recommends smoke detectors	1

C.4.3.1 -Now the Group 6- Consulting Companies opinion:

6.5.4.1) Which are the types of detection devices you normally use and/or recommend?

Grouping	Legend	Quantity
Grouping A	We require detectors but we do not recommend types	1
Grouping B	Smoke + heat	3
Grouping C	Did not answer	5

Combining both opinions we have a majority on combined some and heat detection.

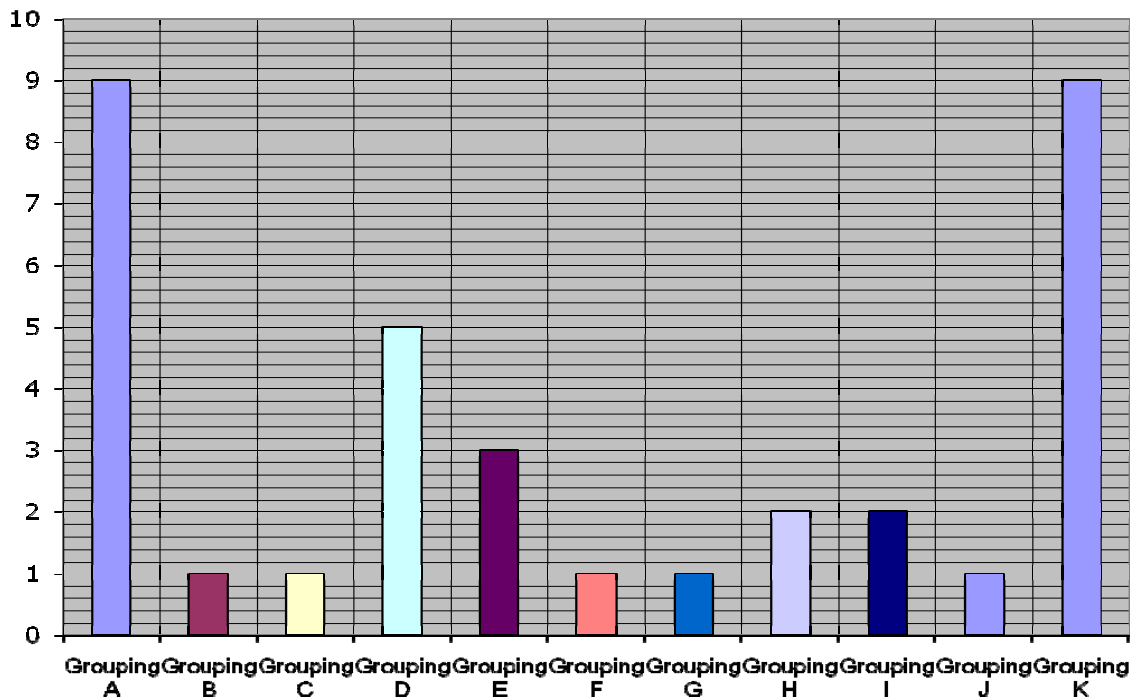
C.5 - Unwanted trip is still a problem in many stations and this item was submitted equally to the three groups in the form of open questions.

As already explained the open questions do allow the possibility to a great quantity of answers and we made a grouping of them for statistical purposes, but the precious original answers are preserved for further consultation and analysis of the interested parties. Every contribution is important and is respectfully treated as a valuable contribution to the involved community.

C.5.1 - The opinion of the Group 1 – Users on how to minimize unwanted trips can be seen in the study below:

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

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	9



To use dual protection, include the generator’s electrical protection and block CO₂ during maintenance show up as most commonly used methods. But as already said here there was made mention to the use of a VESDA system to get more accurate readings and to avoid unwanted trips, it may show to be a tendency.

C.5.2 -Now what the Group 2 - Manufacturers shared with the community about this subject:

2.4.2) Do you recommend any specific detection and control system to minimize unwanted fire extinguishing system operation?

Grouping	Legend	Quantity
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Grouping A	Smoke + heat detectors	3
Grouping B	Smoke + heat detectors + electrical protection	2
Grouping C	Differential relay	1
Grouping D	Depends upon customer's recommendations	1
Grouping E	No recommendation (nothing special)	3

C.5.3 - And now the Group 6 – Consulting Companies information about this item:

6.5.4.2) Do you recommend any specific detection and control system to minimize unwanted fire extinguishing system operation (here is meant the unwanted release of the extinguishing media)?

Grouping	Legend	Quantity
Grouping A	We require it but we do not recommend any specific system	1
Grouping B	We do not recommend (none)	1
Grouping C	We do develop systems together with manufacturers and research institutes	1
Grouping D	Heat	1
Grouping E	Did not answer	5

D – Specific aspects concerning the Group 1 –Users. Other than those already presented in the comparative study.

Here will be made a study, among others, of the presented examples of accidents occurred with generators according to the available data.

To follow...

E – Specific aspects concerning the Group 2 – Manufactures other than those already presented in the comparative study.

To follow...

F – Specific aspects concerning the Group 3 – Insurance Company, Reinsurance Company or Insurance Broker

We believe that the five answers received do bring interesting information to this work therefore they will be analyzed further on.

To follow...

G – Specific aspects concerning the Group 6 – Consulting Companies

To follow...

The planned Groups 4 and 5 did not show significative answers, so they cannot be considered. As explained they would need more effective action from the involved Regular and Observer Members.

At the conclusion of the pertinent analytical work the issue of recommendation may be possible.

Annexes 1) The original complete statistical tables that support the item C 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.

C.1.1.1-

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 Geral (20)	35	10	24	1	3

C.1.1.2-

6.5) Are there standards recommending generator fire protection in your country?					
Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	0	0	0	0	1
New Zealand	0	0	0	0	1
United Kingdom	2	1	1	0	0
Switzerland	1	0	1	0	0
Sweden	3	1	1	1	0
Norway	1	0	1	0	0
Canada	0	0	0	0	1
China	1	1	0	0	0
Spain	0	0	0	0	1
Russia	0	0	0	0	1
Japan	0	0	0	0	1
Germany	1	0	1	0	0
Brazil	0	0	0	0	1

United States	0	0	0	0	1
Mexico	0	0	0	0	1
France	0	0	0	0	1
Total Regular Members (16)	9	3	5	1	10
Observer Members	Answers	Yes	No	Blank	N. Answ
Poland	0	0	0	0	1
Macedonia	0	0	0	0	1
Belgium	0	0	0	0	1
Austria	0	0	0	0	1
Total Observer Members (4)	0	0	0	0	4
Total Geral (20)	9	3	5	1	14

C.1.1.3-

Question	Company	Answer	Coding
2.3) Which Standards do you apply in the design of the fire protection of your generators?	EMP001 (Suíça)	NFPA (international, with country specific sub chapters).	Grouping A
	EMP002 (Brasil)	NFPA	Grouping A
	EMP003 (França)	NFPA	Grouping A
	EMP044 (Japão)	NFPA standard	Grouping A
	EMP050 (Canadá)	NFPA	Grouping A
	EMP057 (Estados Unidos)	NFPA	Grouping A
	EMP034 (Japão)	It depends on the requirement of customer's specification.	Grouping B
	EMP046 (Áustria)	Depends on customer specification.	Grouping B
	EMP021 (China)	For water spray we apply GB50219, CO2 gas GB50193. All they are National standard.	Grouping C
	EMP004 (Noruega)	N/A	Grouping D
Legends of the Groupings of Answers			
Grouping	Legend		Quantity
Grouping A	NFPA (USA)		6
Grouping B	Depends upon customer's requirements		2
Grouping C	Own local standards		1
Grouping D	Not applicable		1

C.1.2.1 –

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 Geral (20)	35	23	9	3	3

C.1.2.2-

<i>2.1) From the generator manufacturer's standpoint, do you recommend the use of Generator Fire Protection?</i>					
Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	0	0	0	0	1
New Zealand	0	0	0	0	1
United Kingdom	0	0	0	0	1
Switzerland	1	1	0	0	0
Sweden	0	0	0	0	1
Norway	1	0	1	0	0
Canada	1	0	1	0	0
China	1	1	0	0	0
Spain	0	0	0	0	1
Russia	0	0	0	0	1
Japan	2	0	2	0	0
Germany	0	0	0	0	1
Brazil	1	1	0	0	0
United States	1	0	1	0	0
Mexico	0	0	0	0	1
France	1	1	0	0	0
Total Regular Members (16)	9	4	5	0	8
Observer Members	Answers	Yes	No	Blank	N. Answ
Poland	0	0	0	0	1
Macedonia	0	0	0	0	1
Belgium	0	0	0	0	1
Austria	1	0	1	0	0
Total Observer Members (4)	1	0	1	0	3
Total Geral (20)	10	4	6	0	11

C.1.2.3 –

6.10) In your opinion is a Generator Fire Protection installation required nowadays?					
Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	0	0	0	0	1
New Zealand	0	0	0	0	1
United Kingdom	2	2	0	0	0
Switzerland	1	1	0	0	0
Sweden	3	1	2	0	0
Norway	1	1	0	0	0
Canada	0	0	0	0	1
China	1	1	0	0	0
Spain	0	0	0	0	1
Russia	0	0	0	0	1
Japan	0	0	0	0	1
Germany	1	1	0	0	0
Brazil	0	0	0	0	1
United States	0	0	0	0	1
Mexico	0	0	0	0	1
France	0	0	0	0	1
Total Regular Members (16)	9	7	2	0	10
Observer Members	Answers	Yes	No	Blank	N. Answ
Poland	0	0	0	0	1
Macedonia	0	0	0	0	1
Belgium	0	0	0	0	1
Austria	0	0	0	0	1
Total Observer Members (4)	0	0	0	0	4
Total Geral (20)	9	7	2	0	14

C.2.1-

1.3) Is there any difference between the present and past fire protection strategies on generators in your organisation?					
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 Geral (20)	35	18	17	0	3

C.2.1.1 -

Question	Company	Answer	Coding
1.3.1) If your organization changed the protection strategy, what are the reasons for the change?	EMP010 (Canadá)	There is no plans to change the existing protection strategy.	Grouping A
	EMP045 (Brasil)	Basically the organization uses the same strategy from de Eighties.	Grouping A
	EMP009 (Japão)	We removed FGP, because the improvement of quality of insulator reduded the number of generator fire.	Grouping B
	EMP019 (Suécia)	see 1.2.1	Grouping B
	EMP023 (Espanha)	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 (Áustria)	Removing CO2 fire fighting plants (hazard for staff), replacing flamable material by flame retardent and self extinguishing material, brazing of stator windings instead of soft soldering.	Grouping B
	EMP012 (México)	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 (Canadá)	We are now using water instead of CO2. Water is not an asphixiant. Personel may be in pit.	Grouping C
	EMP039 (Austrália)	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 (Macedônia)	Many unnecessary activation of fire proteccion of generator	Grouping D
	EMP015 (Nova Zelândia)	Effectiveness and saftey	Grouping E
	EMP021 (China)	The availability and effectiveness .	Grouping E
EMP031 (México)	mejorar y actualizar los sistemas existentes a CO2 y espuma	Grouping E	

EMP025 (Brasil)	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 microswitches 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 microswitches. 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 behaviour, the fire protection system control panel output was connected in series with protections 87G and 87SP.	Grouping F
EMP028 (Japão)	For reducing the human damage in consideration, CO2 is no longer applying to the fire extinguishing system.	Grouping G
EMP032 (Canadá)	Depends on the type of windings, i.e. Themosetting versus Thermoplastic	Grouping H
EMP040 (Noruega)	Change from bitumen based to modern epoxy or polyester based stator winding insulation	Grouping H
EMP047 (Suécia)	The strategy was changed when we started to install epoxy insulated windings (in th of 1960).	Grouping H
EMP048 (Alemanha)	New materials of winding insulation	Grouping H
EMP033 (Nova Zelândia)	More focus on reducing fire risks to personnel, rather than focussing on the generating plant alone	Grouping I
EMP055 (Estados Unidos)	Personnel safety and environmental considerations	Grouping I
EMP056 (Suíça)	früher nur Objektschutz, heute zusätzlich Personenschutz	Grouping I
EMP043 (Japão)	We will change the protection strategy when we find the important defect on fire protection.	Grouping J
EMP008 (Brasil)	not applicable	Grouping K
EMP005 (Suíça)	Did not answer	Grouping L
EMP006 (Suíça)	Did not answer	Grouping L
EMP013 (Brasil)	Did not answer	Grouping L
EMP016 (Brasil)	Did not answer	Grouping L
EMP026 (Suécia)	Did not answer	Grouping L
EMP037 (Rússia)	Did not answer	Grouping L
EMP038 (Suécia)	Did not answer	Grouping L
EMP051 (Áustria)	Did not answer	Grouping L
EMP053 (Polónia)	Did not answer	Grouping L

Legends of the Groupings of Answers

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 devtection	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 behaviour	1
Grouping K	Not applicable	1
Grouping L	Did not answer	9

C.2.1.2 -

1.3.2) Do you intend to change the existing generator fire protection strategy in future and if so please give the reasons.	EMP009 (Japão)	No, we do not install FGP anymore.	Grouping A
	EMP010 (Canadá)	No	Grouping A
	EMP012 (México)	No	Grouping A
	EMP016 (Brasil)	No.	Grouping A
	EMP019 (Suécia)	see 1.2.1	Grouping A
	EMP025 (Brasil)	No	Grouping A
	EMP026 (Suécia)	No	Grouping A
	EMP027 (Macedônia)	no, to change the isolation of windings needs a lot of money.	Grouping A
	EMP031 (México)	no	Grouping A
	EMP033 (Nova Zelândia)	No	Grouping A
	EMP036 (Canadá)	No	Grouping A
	EMP037 (Rússia)	No.	Grouping A
	EMP039 (Austrália)	Our existing strategy has been developed recently and in the process of implementation.	Grouping A
	EMP040 (Noruega)	No, we do not expect any need for strategy change.	Grouping A
	EMP043 (Japão)	We will not change the existing generator fire protection strategy.	Grouping A
	EMP045 (Brasil)	Nowadays there isn't the intention of changing the protection strategy at Tractebel Energia (Brazil)	Grouping A
	EMP051 (Áustria)	No	Grouping A
	EMP053 (Polônia)	No	Grouping A
	EMP015 (Nova Zelândia)	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 (Espanha)	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 (Alemanha)	Yes, in case of refurbishment.	Grouping D	
EMP032 (Canadá)	Depends on the type of windings and air cooled versus water cooled units	Grouping E	
EMP047 (Suécia)	Yes. We will gradually remove the CO2 systems because of the personal risk.	Grouping F	
EMP008 (Brasil)	not applicable	Grouping G	

	EMP028 (Japão)	CO2 is not applied to extinguishing system to reduce the risk of the human damage and the environmental load in consideration.	Grouping G
	EMP055 (Estados Unidos)	Under study at this time. Reasons include maintenance requirements of current system, personnel safety, cost, and new insulation systems in generators.	Grouping H
	EMP056 (Suíça)	siehe 1.3.1	Grouping H
	EMP005 (Suíça)	Did not answer	Grouping I
	EMP006 (Suíça)	Did not answer	Grouping I
	EMP013 (Brasil)	Did not answer	Grouping I
	EMP038 (Suécia)	Did not answer	Grouping I
	EMP054 (Áustria)	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

C.2.2 –

2.2.1) Any change towards the former trend?					
Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	0	0	0	0	1
New Zealand	0	0	0	0	1
United Kingdom	0	0	0	0	1
Switzerland	1	0	1	0	0
Sweden	0	0	0	0	1
Norway	1	0	1	0	0
Canada	1	0	1	0	0
China	1	0	1	0	0
Spain	0	0	0	0	1
Russia	0	0	0	0	1
Japan	2	1	1	0	0
Germany	0	0	0	0	1
Brazil	1	0	0	1	0
United States	1	0	1	0	0
Mexico	0	0	0	0	1
France	1	0	1	0	0
Total Regular Members (16)	9	1	7	1	8
Observer Members	Answers	Yes	No	Blank	N. Answ
Poland	0	0	0	0	1
Macedonia	0	0	0	0	1

Belgium	0	0	0	0	1
Austria	1	0	1	0	0
Total Observer Members (4)	1	0	1	0	3
Total Geral (20)	10	1	8	1	11

C.2.3 –

6.4.1) Do you recognize any change towards the former trend (status quo) in fire protection systems your country?					
Regular Members	Answers	Yes	No	Blank	N. Answ
Australia	0	0	0	0	1
New Zealand	0	0	0	0	1
United Kingdom	2	0	2	0	0
Switzerland	1	1	0	0	0
Sweden	3	0	2	1	0
Norway	1	0	1	0	0
Canada	0	0	0	0	1
China	1	1	0	0	0
Spain	0	0	0	0	1
Russia	0	0	0	0	1
Japan	0	0	0	0	1
Germany	1	0	1	0	0
Brazil	0	0	0	0	1
United States	0	0	0	0	1
Mexico	0	0	0	0	1
France	0	0	0	0	1
Total Regular Members (16)	9	2	6	1	10
Observer Members	Answers	Yes	No	Blank	N. Answ
Poland	0	0	0	0	1
Macedonia	0	0	0	0	1
Belgium	0	0	0	0	1
Austria	0	0	0	0	1
Total Observer Members (4)	0	0	0	0	4
Total Geral (20)	9	2	6	1	14

C.3.1.1 –

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 Geral (20)	35	12	22	1	3

C.3.1.2 –

<i>1.6.1) If no, please indicate which is your sole fire protection system:</i>							
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	CO²	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 Geral (20)	35	14	5	0	5	5	3

C.3.1.3 –

1.6.2) If yes, please indicate which are you're the different fire protection systems you have installed:							
Regular Members	Answers	CO²	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	CO²	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 Geral (20)	35	12	7	4	6	5	3

C.3.2 –

2.2) From your experience, which is the type of generator fire extinguishing method more frequently used nowadays?				
Regular Members	Answers	CO²	Blank	N. Answ
Australia	0	0	0	1
New Zealand	0	0	0	1
United Kingdom	0	0	0	1
Switzerland	1	0	2	0
Sweden	0	0	0	1
Norway	1	0	1	0
Canada	1	0	3	0
China	1	0	1	0
Spain	0	0	0	1
Russia	0	0	0	1
Japan	2	2	2	0
Germany	0	0	0	1
Brazil	1	1	6	0
United States	1	0	1	0
Mexico	0	0	0	1

France	1	1	0	0
Total Regular Members (16)	9	4	16	8
Observer Members	Answers	CO²	Blank	N. Answ
Poland	0	0	0	1
Macedonia	0	0	0	1
Belgium	0	0	0	1
Austria	1	1	2	0
Total Observer Members (4)	1	1	2	3
Total GeraI (20)	10	5	18	11

C.3.3 –

6.4) From your experience, which is the type of generator fire extinguishing method more frequently used nowadays?							
Regular Members	Answers	CO ²	Water Spray	Inergen	Other	Blank	N. Answ
Australia	0	0	0	0	0	0	1
New Zealand	0	0	0	0	0	0	1
United Kingdom	2	0	0	0	0	0	0
Switzerland	1	1	0	1	0	0	0
Sweden	3	0	0	0	0	0	0
Norway	1	0	0	0	1	0	0
Canada	0	0	1	0	0	0	1
China	1	1	0	0	1	0	0
Spain	0	0	0	0	0	0	1
Russia	0	0	0	0	0	0	1
Japan	0	1	1	0	0	0	1
Germany	1	0	0	0	0	0	0
Brazil	0	0	1	0	0	0	1
United States	0	0	0	0	0	0	1
Mexico	0	0	0	0	0	0	1
France	0	0	1	1	0	0	1
Total Regular Members (16)	9	3	4	2	2	0	10
Observer Members	Answers	CO ²	Water Spray	Inergen	Other	Blank	N. Answ
Poland	0	0	0	0	0	0	1
Macedonia	0	0	0	0	0	0	1
Belgium	0	0	0	0	0	0	1
Austria	0	0	1	0	0	0	1
Total Observer Members (4)	0	0	1	0	0	0	4
Total GeraI (20)	9	3	5	2	2	0	14

C.4.1-

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	0	1
Switzerland	3	3	2	2	2	1	0	0	0
Sweden	4	3	2	0	1	1	0	0	0
Norway	1	1	1	0	0	0	0	0	0
Canada	3	2	2	0	2	0	0	0	0
China	1	1	1	1	1	0	0	0	0
Spain	1	1	1	0	0	0	0	0	0
Russia	1	0	0	0	1	0	0	0	0
Japan	3	3	3	1	0	0	0	0	0
Germany	1	1	1	1	1	0	0	0	0
Brazil	7	4	3	2	6	1	1	0	0
United States	1	1	0	1	1	0	0	0	0
Mexico	2	1	2	1	0	0	0	0	0
France	0	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	0
Macedonia	1	0	0	0	1	0	0	0	0
Belgium	0	0	0	0	0	0	0	0	1
Austria	2	1	2	1	0	0	0	0	0
Total Observer Members (4)	4	1	2	2	1	0	0	1	
Total Geral (20)	35	24	23	12	19	3	1	3	

C.4.2 –

2.4) What is the state of the art in the detection in accordance to your experience?							
Regular Members	Answers	smoke	heat	flame	other	Blank	N. Answ
Australia	0	0	0	0	0	0	1
New Zealand	0	0	0	0	0	0	1
United Kingdom	0	0	0	0	0	0	1
Switzerland	1	1	1	0	0	2	0
Sweden	0	0	0	0	0	0	1
Norway	1	1	1	0	0	1	0
Canada	1	1	1	0	0	3	0
China	1	1	1	0	0	1	0
Spain	0	0	0	0	0	0	1
Russia	0	0	0	0	0	0	1
Japan	2	2	2	0	0	2	0
Germany	0	0	0	0	0	0	1
Brazil	1	0	1	0	0	6	0
United States	1	1	1	1	0	1	0
Mexico	0	0	0	0	0	0	1
France	1	1	1	0	1	0	0
Total Regular Members (16)	9	8	9	1	1	16	8
Observer Members	Answers	smoke	heat	flame	other	Blank	N. Answ

Poland	0	0	0	0	0	0	1
Macedonia	0	0	0	0	0	0	1
Belgium	0	0	0	0	0	0	1
Austria	1	1	1	0	0	2	0
Total Observer Members (4)	1	1	1	0	0	2	3
Total Geral (20)	10	9	10	1	1	18	11

C.4.3 –

6.5.4) What is the state of the art in the detection in accordance to your experience?							
Regular Members	Answers	Smoke	Heat	Flame	Other	Blank	N. Answ
Australia	0	0	0	0	0	0	1
New Zealand	0	0	0	0	0	0	1
United Kingdom	2	0	0	0	0	0	0
Switzerland	1	1	1	0	1	0	0
Sweden	3	0	0	0	0	0	0
Norway	1	1	1	0	0	0	0
Canada	0	1	0	0	1	0	1
China	1	1	0	0	0	0	0
Spain	0	0	0	0	0	0	1
Russia	0	0	0	0	0	0	1
Japan	0	2	2	0	0	0	1
Germany	1	0	0	0	0	0	0
Brazil	0	1	0	0	1	0	1
United States	0	0	0	0	0	0	1
Mexico	0	0	0	0	0	0	1
France	0	1	1	0	0	0	1
Total Regular Members (16)	9	8	5	0	3	0	10
Observer Members	Answers	Smoke	Heat	Flame	Other	Blank	N. Answ
Poland	0	0	0	0	0	0	1
Macedonia	0	0	0	0	0	0	1
Belgium	0	0	0	0	0	0	1
Austria	0	0	1	0	0	0	1
Total Observer Members (4)	0	0	1	0	0	0	4
Total Geral (20)	9	8	6	0	3	0	14

C.4.2.1 –

Question	Company	Answer	Coding
2.4.1) Which are the types of detection devices you normally use and/or recommend?	EMP001 (Suíça)	Combined smoke and heat detectors.	Grouping A
	EMP003 (França)	smoke detectors or temperatures detectors. Only one type of detector is not the signature of fire presence (temperature detector can be activated at stand still when the cooling is stopped, smoke detectors can be activated by presence of dust, especially during transient operations such as starting and stopping). Actuation of fire protection with simultaneous acting of a detector (smoke or temperature) with tripping of electrical differential protection of the generator prevents from untimely release of CO ² or water.	Grouping A

EMP021 (China)	Normally we use smoke detector with ionization type and heat detector with temperature fixation type.	Grouping A
EMP034 (Japão)	Smoke and heat.	Grouping A
EMP044 (Japão)	Smoke and heat	Grouping A
EMP050 (Canadá)	Smoke and heat	Grouping A
EMP057 (Estados Unidos)	smoke and heat	Grouping A
EMP002 (Brasil)	TERMICO, TERMOVELOCIMÉTRICO	Grouping B
EMP004 (Noruega)	Heat detection, 4 - 6 detectors inside generator stator upper part, equally distributed around the circumference	Grouping B
EMP046 (Áustria)	Smoke detectors are recommended, but customers also want heat sensors.	Grouping C

Legends of the Groupings of Answers

Grouping	Legend	Quantity
Grouping A	Combined smoke and heat	7
Grouping B	Heat	2
Grouping C	Manufacturer recommends smoke detectors	1

C.4.3.1 –

Question	Company	Answer	Coding
6.5.4.1) Which are the types of detection devices you normally use and/or recommend?	EMP011 (Suíça)	We require the application, however, neither recommend nor favorize certain types of detection devices.	Grouping A
	EMP021 (China)	2.4.1	Grouping B
	EMP042 (Noruega)	Smoke/heat	Grouping B
	EMP049 (Suécia)	Smoke detectors	Grouping B
	EMP014 (Reino Unido)	Did not answer	Grouping C
	EMP030 (Alemanha)	Did not answer	Grouping C
	EMP035 (Reino Unido)	Did not answer	Grouping C
	EMP041 (Suécia)	Did not answer	Grouping C

Legends of the Groupings of Answers

Grouping	Legend	Quantity
Grouping A	We require detectors but we do not recommend types	1
Grouping B	Smoke + heat	3
Grouping C	Did not answer	4

C.5.1 –

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 (Brasil)	dual detection method	Grouping A
	EMP010 (Canadá)	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 (México)	Una detección de temperatura y mínimo dos de humo	Grouping A

EMP031 (México)	deteccion de temperatura y deteccion de humo	Grouping A
EMP036 (Canadá)	Dual detection	Grouping A
EMP047 (Suécia)	dual detection	Grouping A
EMP054 (Áustria)	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 (Suíça)	dual detection method	Grouping A
EMP006 (Suíça)	There is no protection for unwanted release existing	Grouping B
EMP015 (Nova Zelândia)	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 (Brasil)	The system is released only if the generator differential relay operates.	Grouping D
EMP025 (Brasil)	Connection of fire protection control panel output in series with generator electrical protection relays.	Grouping D
EMP032 (Canadá)	Same as 1.10.1 of the above	Grouping D
EMP045 (Brasil)	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 (Suécia)	The CO2 system is blocked when there is work going on inside the generator i.e inspection.	Grouping E
EMP023 (Espanha)	By blocking fire detection signals during outages and maintenance tasks.	Grouping E
EMP055 (Estados Unidos)	Clearnace system (lockout-tagout), manual "off" switch and manual blocking of release devices.	Grouping E
EMP053 (Polônia)	Mechanical stoppers during generator overhaul	Grouping F
EMP027 (Macedônia)	Manually activated	Grouping G
EMP033 (Nova Zelândia)	Dual detection method employing a voting system, see answer to Q1.10.1 above.	Grouping H
EMP039 (Austrália)	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 eachs control board to reduce risk of multiple releases.	Grouping H
EMP043 (Japão)	We check the fire alarm at a certain intervals.	Grouping I
EMP048 (Alemanha)	periodic check	Grouping I
EMP021 (China)	The fire extinguishing system will be released in case of:a)Some of settling smoke detectors actuated;b) Some of settling heat detectors actuated;c)Differential and or neutral protection already tripped off;d)Circuit breaker of high voltage side of main transformer and deescalation breaker already tripped off.	Grouping J
EMP005 (Suíça)	Did not answer	Grouping K
EMP009 (Japão)	Did not answer	Grouping K
EMP013 (Brasil)	Did not answer	Grouping K
EMP026 (Suécia)	Did not answer	Grouping K
EMP028 (Japão)	Did not answer	Grouping K
EMP037 (Rússia)	Did not answer	Grouping K

	EMP038 (Suécia)	Did not answer	Grouping K
	EMP040 (Noruega)	Did not answer	Grouping K
	EMP051 (Áustria)	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 (eg. 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

C.5.2 –

Question	Company	Answer	Coding
2.4.2) Do you recommend any specific detection and control system to minimize unwanted fire extinguishing system operation?	EMP001 (Suíça)	More than one detector of each type has to tripp an alarm. Alarms could be correlated with other signals like unusual temperature rise in winding for example.	Grouping A
	EMP050 (Canadá)	2 different types of detectors in series to avoid false detection	Grouping A
	EMP057 (Estados Unidos)	use different types of detectors	Grouping A
	EMP003 (França)	We normally recommend now launching of fire protection by simultaneous actuation of smoke /d temperature detectors with the electrical differential protection. Actuation of both types of detectors (temperature and smoke) can release the fire protection in other cases.	Grouping B
	EMP021 (China)	Yes,please refer to item 1.11	Grouping B
	EMP034 (Japão)	Differential relay	Grouping C
	EMP046 (Áustria)	Applied system mainly depends on customer's overall plant fire protection philosophy.	Grouping D
	EMP002 (Brasil)	NO	Grouping E
	EMP004 (Noruega)	No	Grouping E
	EMP044 (Japão)	Nothing special.	Grouping E
Legends of the Groupings of Answers			
Grouping	Legend		Quantity
Grouping A	Smoke + heat detectors		3
Grouping B	Smoke + heat detectors + electrical protection		2
Grouping C	Differential relay		1
Grouping D	Depends upon customer's recommendations		1
Grouping E	No recommendation (nothing special)		3

C.5.3 –

Question	Company	Answer	Coding
6.5.4.2) Do you recommend any specific detection and control system to minimize unwanted fire extinguishing system operation (here is meant the unwanted release of the extinguishing media)?	EMP011 (Suíça)	We require the application, however, neither recommend nor favorize certain types of detection devices.	Grouping A
	EMP042 (Noruega)	None	Grouping B
	EMP021 (China)	We have a closed relationship with the manufacturers, research centres and the design institute. As a result, an agreement is reached to minimize unwanted fire extinguishing system operation as stated in clause 1.11 above.	Grouping C
	EMP014 (Reino Unido)	Heat	Grouping D
	EMP030 (Alemanha)	Did not answer	Grouping E
	EMP035 (Reino Unido)	Did not answer	Grouping E
	EMP041 (Suécia)	Did not answer	Grouping E
	EMP049 (Suécia)	Did not answer	Grouping E
Legends of the Groupings of Answers			
Grouping	Legend		Quantity
Grouping A	We require it but we do not recommend any specific system		1
Grouping B	We do not recommend (none)		1
Grouping C	We do develop systems together with manufacturers and research institutes		1
Grouping D	Heat		1
Grouping E	Did not answer		4

Annexes 2 - As mentioned in the text with numerical references:

The indicated numbers are those that appear in the text.

1) "Fire extinguishing in large salient pole machines" by Dr. R.D. Kranz - issued in 1981 and published in 1985 by the Nr. 103 of Electra available for download under the Internet address:

<http://www.gromow.com/CIGRE/Dr.Kranz-Report-ELECTRA.pdf>

2) "Experience UPDATE Questionnaire" available for download under the Internet address:

<http://www.gromow.com/CIGRE/A1.02-03-Questionnaire-Experience-Update-200070703b.doc>

3) Package of dedicated personalized documents sent individually to each one of the Regular and Observer Members as indicated by the secretary Mr. Joho, please refer to the detailed explanation of the big effort made in this case, using techniques of motivational letters with explanations and coming down to the use of flux diagrams to help the understanding of what was required from each involved party by means of a more visual representation of the tasks as a whole (here is not enough to stress that the Convener was ALWAYS available to deliver support which was seldom required):

3.1) Regular Members:

-Message for the Regular Members (sent to each one of them per separate mail)

-Motivational letter for Cigré members of a particular influence area of a Regular Member (should be signed and sent together with the questionnaire or the corresponding link to the members) and that was distributed and/or made available for download under the Internet address:

<http://www.gromow.com/CIGRE/P1-Regular-CIGRE-members-letter.doc>

-Letter for the Insurance companies explaining about Cigré and about the aim of the UPDATE Works to be sent to the local insurance companies in the Regular Member jurisdiction area (unfortunately very little action made in this respect) and that was distributed and made available for download under the Internet address:

<http://www.gromow.com/CIGRE/P2-Insurance-Companies-letter.doc>

-Letter for the Consulting companies explaining about Cigré and about the aim of the UPDATE Works to be sent to the local insurance companies in the Regular Member jurisdiction area (unfortunately very little action made in this respect) and that was distributed and/or made available for download under the Internet address:

<http://www.gromow.com/CIGRE/P3-Consulting-Companies-letter.doc>

-The working plan was detailed in the message sent to the Regular Members but a scheme was made to give more details and that was distributed and/or made available for download under the Internet address:

<http://www.gromow.com/CIGRE/Working-Plan-Suggestion-01-d.doc>

- Not happy with all this documentation the Convener decided to issue a simplified flux diagram to the Regular give a vision of the procedures involved in the UPDATE at a glance and that was distributed and/or made available for download under the Internet address:

<http://www.gromow.com/CIGRE/Diagram-for-A1-Regular-Members.pdf>

3.1) Observer Members:

-Message for the Observer Members (sent to each one of them per separate mail)

- Similar procedure with Motivational letters for Cigré members, Insurance Companies and Consulting Companies was made for the Observer Members.

-The working plan was detailed in the message sent to the Observer Members but a scheme was made to give more details and that was distributed and/or made available for download under the Internet address:

<http://www.gromow.com/CIGRE/Working-Plan-Suggestion-02-d.doc>

- Not happy with all this documentation the Convener decided to issue a simplified flux diagram to give to also for the Observer Member a vision of the procedures involved in the UPDATE at a glance and that was distributed and/or made available for download under the Internet address:

<http://www.gromow.com/CIGRE/Diagram-for-A1-Observer-Members.pdf>

4) Actualized Follow-Up UPDATE Table:

In order to keep track of the activities that involved initially 24 Regular Members and 10 Observer Members as indicated by Mr. Joho, the Convener developed an MS Excel table with the pertinent data that was meant to be updated on routine basis and that gives the perspective of the participation and of the received answers and that was made available for download under the Internet address:

Additional comments to the Internet Working Page:

The decision was made by the Convener to launch such a page in order to allow contact via Internet and the download of document as well as to back up the received documents providing transparent work to the interested involved parties. A link allowing direct contact with the Convener via mail form is also provided. Since the use of the Cigré data base for this purpose would demand long a clarification time the Convener used its own domain (gromow.com) and private hosting facilities to implement this page. The access to this page can be made via the address:

<http://www.gromow.com/CIGRE/working-page.htm>

5) Correlation table of those original Questionnaire’s item numbers that were changes to adapt them to the statistical work, the following changes were made:

Equivalence between original and NEW numbering
Original 3.4.4) - NEW 3.4.5) Was the refund paid?
Original 5.3.2) - NEW 3.4.1) If, yes, please give a brief explanation. Here it is interesting to know the innovations achieved on the extinguishing processes – compared with the existing solution; including the fire detection and the resulting environmental improvements:
Original 5.4) - NEW 5.5) According to your opinion, is there any question that is missing in this part of the questionnaire?
Original 6.6) - NEW 6.5.3) 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?
Original 6.5) - NEW 6.5.4) What is the state of the art in the detection in accordance to your experience?
Original 6.5.1) - NEW 5.5.4.1) Which are the types of detection devices you normally use and/or recommend?
Original 6.5.2) - NEW 6.5.4.2) Do you recommend any specific detection and control system to minimize unwanted fire extinguishing system operation (here is meant the unwanted release of the extinguishing media)?

6) **INERGEN** is a trademarked Fire suppression product of Ansul Corporation. Inergen is a blend of inert atmospheric gases that contains 52.5% nitrogen, 40% argon, 8% carbon dioxide [ref: Ansul Inergen MSDS Form F-9313-7]. It is considered a clean agent for use in gaseous fire suppression applications. Inergen does not contain halocarbons, and has no ozone depletion potential. It is non-toxic. Inergen is used at design concentrations of 40-50% to lower the concentration of oxygen to a point that cannot support combustion.

A component of Inergen is carbon dioxide, which allows the human body to adapt to the environment of reduced oxygen that is present after discharge of agent. Discharge of Inergen results in an approximate 3% concentration of carbon dioxide within the space. This directs the human body to take deeper breaths and to make more efficient use of the available oxygen.

The nitrogen and argon components are used to offset the weight of the carbon dioxide, which allows the Inergen blend to have the same density as normal atmosphere. This is done in order to prevent special considerations from needing to be taken in order to prevent agent leakage.

7) **VESDA** aspirating smoke detectors provide the earliest possible warning of an imminent fire hazard. Why is this important? It buys time, to investigate a smoke alarm, to take action, to avoid the danger, damage and disruption caused by fire.

It works: Continually drawing air into a pipe network attached to a detector unit. Passing the air through a dual stage filter to remove dirt. Sending the clean air to a laser detection chamber for smoke detection. Measuring the light scatter caused by any smoke. Processing the detector signal and presenting the smoke level graphical. Communicating the information to a fire alarm control panel, a software management system or a building management system.

Final Note for this draft preliminary stage:

Work to be continued exploring the other collected data...

Here I would like to express the gratitude for those who followed me up to this stage by giving answers and their support which I hope to receive up to the completion of this task.

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