[TPR 2]

France’s answers to generic questions

# Fire safety analysis

## Screening criteria used in the fire analysis for those NPP that have not explicitly identified these.

**Tricastin**

The screening criteria used in the fire analyses depend on the analyses considered. The aim of these criteria is typically to target the detailed analyses on the most sensitive configurations.

As an example, the "Analysis method" (p23) details PFG, PFL and non-PFL criteria to characterize the fire to be studied in a given room. Refer also to Annex A of the standard ISO 18195 for further details.

As another example, the "Fire PSA" (p28) details successive PSA phases targeting the detailed analyses on the most sensitive fire volumes.

## Fire safety objectives: Not clearly stated. In particular, clarification is requested regarding the purpose of the deterministic fire risk assessment: has it been carried out with the purpose of protecting the lives of operators or of preventing nuclear accidents?

**RHF**

Fire Safety Objectives are defined in the light of preventing nuclear accidents only, following deterministic approach.

## Defence in Depth (DiD): Regarding the level of fire DiD and the assumptions in the Fire Safety Analyses (FSA) the following questions arise:

Has the failure of the fire protection means (features such as structures, systems and equipment, but also human failures in active fire protection) been taken into account in the fire analysis for the safety demonstration of the fire protection structures, systems and components (SSCs)?

**Tricastin**

The possible failure of some of the fire protection means is considered in the deterministic fire analyses through sensitivity analyses. Refer to "Aggravating factor" (p26) for further details on the approach followed for active and passive equipment.

Sensitivity analyses related to manual actions are carried out to check the absence of “cliff-edge effect” linked to the consideration of operator intervention times. Refer to "Operator intervention times" (p27) for further details.

**RHF**

Taken into account in the FSA since ILL postulate total destruction of PIC's by fire and then assess consequences. For C level of reactor building (experimental level), combination of solutions are used: fire loads management, fire detection, punctual passive protection (i.e: pillars) and soon sprinkler system (2025).

**Silo 130**

Analysis of the unavailability or failure of a fire-related risk control provision is included in the fire-related risk control plan for the workshops (at the design stage or during safety reassessments during periodic reviews).

**Osiris**

As indicated in the chapter I-2.6.2 of the French National Report, identification of targets is carried out focusing on the SSCs needed to reach and maintain a safe state, vulnerable to the direct or indirect effects of a fire and that does not have a segregated functional redundancy to ensure that they are robust to the effects of a given fire scenario. This robust segregation refers to the robustness of failure of one of the fire protection means.

During specific analyses phase, the "aggravated scenarios” are also studied following the application of failure of one of the fire protection means.

Globally, this failure does not apply to the passive, static, robust, correctly sized and maintained fire protection means.

**UNGG**

The possible failure of some of the fire protection means is considered in the deterministic fire analyses through sensitivity analyses. Refer to "Aggravating factor" (p26) for further details on the approach followed for active and passive equipment.

Sensitivity analyses related to manual actions are carried out to check the absence of “cliff-edge effect” linked to the consideration of operator intervention times. Refer to "Operator intervention times" (p27) for further details.

Both in the deterministic and probabilistic FSA, under which assumptions is this failure considered: full burnout in the fire area and failure of all SSC therein, functions of failure probability for the different SSCs, no damage due to the fire?

**Tricastin**

The assumptions under which the failure of targets is considered depend on the analyses considered.

For Fire PSA, refer to "Fire PSA" (p28) for further details. For deterministic studies, refer to "Analysis method" (p22) and "Aggravating factor" (p26) for further details.

**RHF**

full burnout in the fire area and failure of all PIC's

Under these considerations, do you consider your Fire PSA conservative or realistic?

**Tricastin**

By nature PSA are realistic studies, however for practical reasons conservative assumptions may be considered to simplify the analyses. The Fire PSA include both conservative and realistic aspects, depending on the Fire PSA phase considered. As described in "Fire PSA" (p28), "The overall risk of core melt (RFC) associated with the fire PSA is then the sum of the worst-case estimated RFCs for the fire volumes quantified in phase 2 and the more realistic RFC of the fire volumes quantified in phase 3.".

**RHF**

very conservative indeed!

Could you provide (in case a Fire PSA is performed) results in terms of CDF / LRF / LERF?

**RHF**

ILL does not perform PSA. However, the FSA indicates radiological consequences at 500 m for rooms or buildings containaning radiological substances. The maximum release is 0,8 msv at 500 m reached for ILL27 building (in case of release at 0m height, no redeposition, no filtration, DF3,5 conditions). For chemicals (if released in totality, 0m height, DF3,5 conditions) the max concentration at 500 m is < 39 mg/m.

Is the single failure criterion considered in the fire analysis? If it is, on which regulatory basis and how is it considered?

**Tricastin**

The single failure is considered in the fire analyses through the application of an aggravating factor. Refer to "Aggravating factor" (p26) for further details.

**RHF**

The single failure is not considered.

**Silo 130**

The fire analysis for silo 130 implicitly takes into account a single failure criterion:

* with regard to fire detection: if a fire detection system fails, a fault signal is sent to the control room and to the PCS-PSM;

fire extinguishing: argon (extinguishing agent) is supplied via 2 normal argon lines equipped with automatic valves. In the event of a fault in one of the lines or a loss of compressed air, the valves can be operated manually. There is also a 3ème emergency line with manual valves.

**Osiris**

This criterion is taken into account in FSA. The regulatory requirement corresponds to article 4.4.10 of ASN Decision No. 2015-DC-0532.

The application of failure of fire protection means is indicated in the answer to the previous question.

Regarding the FSA of BNI 40 (OSIRIS), the assessment of radiological consequences induced by fire scenarios does not consider nuclear ventilation (filtration efficiency not being credited and release being considered at ground level and not through the emissary).

**UNGG**

The single failure is considered in the fire analyses through the application of an aggravating factor. Refer to "Aggravating factor" (p26) for further details.

Are the spurious actuation of signals by a fire and the false operation of fire protection SCCs considered in the analyses? In what way?

**Tricastin**

The unintentional operation of an electrical equipment, due to a spurious signal, is taken into account in the fire PSA studies.

In order to prevent or limit the consequences of spurious signals, “EDF has drawn up incidental or accidental rules of conduct, known as “FAIop” (for Fiche action incendie opérateur – operator fire action sheet), which define the actions and guidelines to be followed in the event of a confirmed fire in certain electrical rooms supplying safety equipment, in order to return to a safe state using only equipment not likely to be affected by the fire”. Refer to A-I-3.2.3.4 "Managing the functional consequences of a fire" (p142) for further details. “

**RHF**

Yes they are considered, all detections are confirmed locally by the staff.

Provide information on which combinations of fires and other events have been included in the fire analysis with their justification. Please refer to Appendix I of the IAEA SSG-64 to address possible combinations of events.

**Tricastin**

The considered combinations of fires and other event are described in "Combinations" (p21).

**RHF**

ILL approach exhibited in its Safety Report is different: for some incidental scenarii, fire has been taken into consideration as an aggravating condition.

**Framatome Romans**

Combination events taken into account are:

For consequent (subsequent) events:

* fire followed by criticality accident. The criticality accident detection system is installed by distribution of the sensors around different fire volumes to prevent their simultaneous failure caused by the same fire (cf. § II-2.3.4). The fire-fighting means take into account the criticality risk (cf. § C-II-3.2.2.2 and C-II-3.2.2.3). The loss of stability of metallic structures under the effect of a fire is also taken into account where a criticality control mode (location, geometry…) may be lost in the instance of collapse.
* earthquake followed by fire. As mentioned in § C-II-3.2.1.2 and C-II-3.2.2.2 in this case the electrical power supply (normal, backed-up and permanent) of the entire site is automatically cut off, with some exceptions. The supply of hazardous fluids is also cut off. These measures reduce the risk of a fire outbreak, also combined with other hazards (e.g. explosion). The On-Site Emergency Plan is activated, the impact on internal roads and access ways taken into account as well (see paragraphs C-II-3.2.3.2 and C-II-3.2.3.3).
* fire followed by explosion / explosion followed by fire. Through the FDS, programmed interlocks based either on fire or gas detection place the facility in safety condition to prevent these situations (cf. § C-II-3.2.1.2).

For correlated event:

* earthquake followed by explosion and fire. See the interlocks mentioned before. In addition, a seismic event leads to the activation of the On-Site Emergency Plan (PUI, see paragraphs C-II-3.2.3.2 and C-II-3.2.3.3). A operational organisation is then deployed.

For unrelated (independent) events:

* loss of power supply and fire. Backup electrical power supply is available for the monitoring and signalling equipment, and the PCC building has its own electrical power supply equipment (see § C-II-3.2.1.2).

In the instance of any significant event (e.g. heavy snowfall), the On-Site Emergency Plan (PUI, see paragraphs C-II-3.2.3.2 and C-II-3.2.3.3) is activated and the installations are brought in a safe state.

**MELOX**

The accumulation of events is the subject of a specific analysis. This analysis considers the plausible cumulation of two independent events. In MELOX, the occurrence of a fire can be combined with a second type of events : pressure equipment failure, load drop, or 2nd fire occurrence.

The combination of a fire with another event not mentioned above is considered implausible or of very low probability in view of the characteristics of the site. The analysis shows the absence of an aggravated situation despite the loss of line of defense due to the second event.

**Pool D - T0**

On the basis of Orano La Hague's experience of events, the following cumulative rules for independent events have been established:

|  |  |
| --- | --- |
| **Terminology used** | **Cumulative events studied (accumulation of independent events)** |
| **Fire outbreak**= fire does not develop into a fire (only the equipment at the origin of the fire loses its integrity) | An event with a relatively low probability of occurrence that can be combined with another independent event. The accumulation of two outbreaks of fire is not systematically retained and depends in particular on the sources of ignition present in these premises.  |
| **Developed fire**= development of a room-wide fire (loss of all the room's targets), although contained by the extinguishing systems | An event with a low probability of occurrence that can only be combined with another plausible independent event in the life of the installation. The accumulation of two developed fires or one developed fire with a fire outbreak is not considered. |
| **Widespread fire**= fire spreading outside the premises | No case of accumulation retained (accumulation with any other independent event highly unlikely) |

The "outbreak of fire" / "developed fire" event is combined with any other dreaded event whose initiator is independent of the "outbreak of fire" / "developed fire" event and whose combination is considered plausible (depending on the probability and location of the events). The independent accumulation of an external attack with a fire is not considered because it is assessed as implausible (due to the probability).

The dreaded events are probabilised according to the initiating event considered (for example: the probability of the dreaded event "pipe rupture" is different depending on whether the initiating event is an earthquake or the fall of a heavy load).

In demonstrations of the control of fire-related risks, an outbreak of fire with the combustion of all the combustible materials is postulated as soon as a source of ignition is present, in order to check the adequacy of the lines of defence with respect to the targets to be protected from the effects of a fire.

The fire risk(s) induced by an event (falling load, earthquake, etc.) are taken into account by means of specific provisions (verification of a floor's resistance to falling loads, automatic seismic detection and shutdown system, etc.). A triggering event can generate one or more induced risks. For example, an earthquake can cause a load to fall, leading to a fire.

The detection and extinguishing systems are designed to cope with two fires, which may or may not be correlated. The fire detection and location systems remain operational even in the event of a loss of electricity, making it possible to manage correlated events (including a fire).

**Silo 130**

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The detection and extinguishing systems are dimensioned on the basis of two fires, which may or may not be correlated. The fire detection and location systems remain functional even in the event of a loss of electricity, making it possible to manage correlated events (including a fire).

**Osiris**

For BNI 40 (OSIRIS), the analysis of combinations of fires and other events is not included in the main fire risk management study but is treated in a separate specific study. Three types of combinations are taken into account:

* two external origin events,
* two internal origin events,
* an external origin event with an internal origin event (such as fire or internal failure for example). Combinations of a fire with an independent event were studied.
* Combinations of triggering events are excluded if one of the following criteria is satisfied :
* radiological consequences on the public might be lower or equal than those of the triggering events taken separately,
* the associated probability is lower or equal than 10-7/year.

These analyzes showed that these combinations should lead to consequences on the public of less than 1 mSv (at 48 hours, for an adult located near the CEA site) and therefore that no additional provisions were to be implemented in the facility.

**UNGG**

The considered combinations of fires and other event are described in "Combinations" (p21).

With regard to these combinations of fires with other events in the analysis, is the failure of the fire protection features (for detection or suppression) caused by combined hazards – such as earthquake and consequential fire or a fire occurring coincidentally with a long-lasting external flooding – considered? What are the qualification requirements ensuring their required function during and after these events?

**Tricastin**

The considered combinations of fires and other events are described in "Combinations" (p21).

Within this framework, a fire occurring coincidentally with a long-lasting external flooding is not considered.

Within this framework, “an earthquake is not assumed to be a fire initiator in the safety-classified civil engineering structures. Nonetheless, the fire protection equipment required by the safety case complies with the Operating Basis Earthquake (OBE) requirements in terms of seismic resistance and is confirmed for the Safe Shutdown Earthquake (SSE). In any case, the fire protection equipment are checked to ensure that should it fail in the event of an earthquake it does not represent a hazard for safety-classified equipment or is not itself damaged by the possible failure of any non-seismic classified equipment.”

**Framatome Romans**

See previous answer.

**MELOX**

Automatic fire detection and extinguishing systems are not qualified to keep functional after an earthquake. After Fukushima, thermal probes have been installed to signal an abnormal rise in temperature in different locations post-earthquake.

Due to the altitude of the site, external flooding does not affect the fire detection and extinguishing functions.

**Pool D - T0**

In the event of an initial event leading to the facility being placed in a safe state, a fortiori following an accidental situation caused by a seismic hazard, palliative measures would be implemented to restore the lost function(s). Normal operation would not be resumed until the damage had been fully repaired. With regard to flooding risks, measures have been taken to rule out any lasting internal flooding scenario (shutdown of utilities following an earthquake, etc.). The Orano La Hague site is not affected by any lasting external flooding scenario (site location).

**Silo 130**

In the event of an initial event leading to the facility being placed in a safe state, a fortiori following an accidental situation caused by a seismic hazard, palliative measures would be implemented to restore the lost function(s). Normal operation would not be resumed until the damage had been fully repaired. With regard to flooding risks, measures have been taken to rule out any lasting internal flooding scenario (shutdown of utilities following an earthquake, etc.). The Orano La Hague site is not affected by any lasting external flooding scenario (site location).

**Osiris**

In case of combinations of fires with other events, failure of the fire protection features is not taken into account due to the acceptability of the radiological impact of these situations.

**UNGG**

The considered combinations of fires and other events are described in "Combinations" (p21).

Within this framework, a fire occurring coincidentally with a long-lasting external flooding is not considered.

Within this framework, “an earthquake is not assumed to be a fire initiator in the safety-classified civil engineering structures. Nonetheless, the fire protection equipment required by the safety case complies with the Operating Basis Earthquake (OBE) requirements in terms of seismic resistance and is confirmed for the Safe Shutdown Earthquake (SSE). In any case, the fire protection equipment are checked to ensure that should it fail in the event of an earthquake it does not represent a hazard for safety-classified equipment or is not itself damaged by the possible failure of any non-seismic classified equipment.”

Consideration of the different Plant Operational States (POSs) and/or operating status and modes in the deterministic FSA.

**Tricastin**

The different Plant Operational States considered are described in "Operating states" (p20). In particular, “the fire is postulated as breaking out in normal conditions of plant unit operation, or in long-term post-accident conditions, that is after a time of about 6 to 12 hours. In practice, depending on the accident (see further on for the combined situations considered), this time is sufficient for the backup systems to be in the acquired configuration or to be configurable by local actions.” In this sentence, “normal conditions of operation” include all possible state of the reactor : at-power, at-shutdown including refueling.

**RHF**

See answer to question FR-E-749 specific ILL: The analyses cover all the situation of the facilities including reactor in operation states for the consequences for fire analysis ; since they have been identified as majoring potential consequences following a fire. During outages, where many works occur, an additional fire risk analysis are systematically part of global risk analysis performed before works are authorised.

## Inventory make-up: Please provide a higher level of detail on the systems used to make-up inventory.

**Pool D - T0**

Articles 3.5 and 3.6 of the amended Order of 7 February 2012, known as the "INB Order", respectively establish the list of internal and external hazards to be taken into account in the safety demonstration, including the plausible cumulative effects of these hazards. This list is supplemented as necessary depending on the characteristics of the facility.

## Applicability of PSA: According to the Technical Specifications of the TPR II, performance of Fire Probabilistic Safety Assessment is considered mandatory for NPPs. However, it would be useful to know if Fire PSA have been performed or are intended to be performed for the waste storage facilities.

**Silo 130**

Probabilistic safety studies are not carried out for the waste storage facilities of the La Hague nuclear materials processing establishment.

## Applicability of PSA: According to the Technical Specifications of the TPR II, performance of Fire Probabilistic Safety Assessment is considered mandatory for NPPs. However, it would be useful to know if Fire PSA have been performed or are intended to be performed for the decommissioning facilities.

**Osiris**

The CEA does not perform PSA for decommissioning facilities on the subject of fire hazard. The deterministic analysis is considered as sufficient.

**UNGG**

As indicated in section II-2.6.1, as part of the safety demonstration for BNI no46, envelope accident scenarios are identified by means of a risk analysis irrespective of the probability of occurrence.

The consequences of these scenarios are studied deterministically in order to assess the associated severity and demonstrate their acceptability in terms of the interests protected, whatever the probability of the accident occurring, using the benchmark value associated with the most frequent events.

There is therefore no need to carry out a probabilistic analysis in this case, given the objective sought.

## Fire resistance/fire hazard rating: The fire resistance rating of fire compartments, or fire hazard level, is often determined based on the fire load density (MJ/m²) in every fire area or compartment accounting for both permanent and transient fire loads and potential ignition sources.

Provide details on the rationale followed.

**Tricastin**

The rationale followed for the justification of the robustness of fire safety volume sectorisation elements is detailed in "Analysis method" (p22) and "New method for justification of sectorisation" (p25).

As described in “A-I-3.1.3.3. Overview of actions and implementation status” (p95), “With regard to the management of temporarily stored fire loads, EDF is currently looking into ways of improving this topic, based on the principle of bringing the conditions of application of the temporary fire load storage rules into line with the DMRI, according to the reference state of each plant unit. The approach is based on using the available fire studies to identify the possibilities of temporary storage of fire loads in premises that do not call into question the conclusions of these studies. These temporary storage possibilities shall be interlinked with the recurrent needs identified by the licensee and implemented by sharing the best practices available and/or already applied by the sites. They shall be defined with the aim of adapting the means used to the risks (temporary storage prohibited in certain sensitive places, restriction of the quantities or nature of the fire loads stored, setting up appropriate compensatory means, etc.).

In this context, EDF is developing a methodology which aims to use the fire studies to identify temporary storage possibilities within the premises for all the plant units.”

**RHF**

See NAR §B 3.1.1 and 3.1.2 "Means of prevention", B 3.1.2 "Overview of arrangements for management and control of fire load and ignition sources" and answers to questions FR-C-204 and FR-C-211.

**Framatome Romans**

As described in § C-II-3.3.1.1 and C-II-3.3.1.2 of the report, the fire sectors are REI 120, and EI 120 for the openings. The prevention measures aimed at limiting the fire loads and managing the ignition sources (cf. § C-II-3.1.1) are deemed adequate. In complement, rooms with high fire loads (electrical installations) are when needed protected by a fixed gas extinguishing system (cf. § C-II-3.2.2.1).

**MELOX**

The fire sectors were determined, according to the regulations applicable at the time of the design of the plant, with objectives to limit fire load. The fire sectors have a fire load greater than 400 MJ/m2 and less than 1800 MJ/m2 (1100 MJ/m2 for locations containing nuclear material).

**Silo 130**

When designing the most recent installations, a correlation between the heat load density and the fire compartmentation was defined on the basis of a normative reference. In particular, premises whose heat load density exceeded 600 MJ/m² were classified as “fire sectors”. The fire resistance of these premises was set with a fire rating of two hours. More generally, as a variation of this principle, functionalities of premises, synonymous with a high heat load density, were retained for such classification (electrical premises, IT premises, control room, etc.). A fire sector is thus equipped with fire walls of degree two hours and all the crossings and openings of such a room also have this same qualification. In the operational phase, this functionality approach, synonymous with high heat load density, is maintained to assess the need for fire compartmentation.

The data from the normative reference framework were established on the basis of outbreaks in an open environment. The oxygen necessary for complete combustion of the fuel is available under these conditions. In a confined and under-ventilated environment, combustion is quickly conditioned by the available oxygen. Using these values from the literature therefore provides an envelope approach. Indeed, in a confined, under-ventilated environment, the fuel cannot release all of its energy due to constraints linked to the ventilation of the premises.

**Osiris**

The justification of the sufficiency of the fire resistance rating of fire compartments is based on a qualitative approach taking into account the following criteria:

* fire loads (permanent and transient fire loads such as a forklift in an airlock) and type of fire scenario that could be induced (heat release rate, flashover phenomenon, etc.),
* the adequacy between fire resistance performances (duration and thermal stress) and the intervention capacities of the rescue teams.

If necessary, the qualitative justification can be supplemented by a quantitative justification (quantification of thermal stress, etc.).

**UNGG**

The rationale followed for the justification of the robustness of fire safety volume sectorisation elements is detailed in "Analysis method" (p22) and "New method for justification of sectorisation" (p25).

As described in “A-I-3.1.3.3. Overview of actions and implementation status” (p95), “With regard to the management of temporarily stored fire loads, EDF is currently looking into ways of improving this topic, based on the principle of bringing the conditions of application of the temporary fire load storage rules into line with the DMRI, according to the reference state of each plant unit. The approach is based on using the available fire studies to identify the possibilities of temporary storage of fire loads in premises that do not call into question the conclusions of these studies. These temporary storage possibilities shall be interlinked with the recurrent needs identified by the licensee and implemented by sharing the best practices available and/or already applied by the sites. They shall be defined with the aim of adapting the means used to the risks (temporary storage prohibited in certain sensitive places, restriction of the quantities or nature of the fire loads stored, setting up appropriate compensatory means, etc.).

In this context, EDF is developing a methodology which aims to use the fire studies to identify temporary storage possibilities within the premises for all the plant units.”

Fire load criteria values may differ amongst facilities and countries depending on the regulatory framework. How are these respective criteria justified?

**Tricastin**

The fire loads criteria PFG, PFL and non-PFL used are detailed in "Analysis method" (p23). In order to characterise the fires to be studied, “the identification, location, concentration and nature of combustible masses are taken into account”. These criteria are established using principles similar to those expressed in the Annex A of the standard ISO 18195. Refer also to Annex A of the standard ISO 18195 for further details.

**Framatome Romans**

This question calls for an answer at national level. As mentioned in the document, Framatome Romans complies with the regulations and standards in effect.

**MELOX**

Todays, French regulations no longer impose a quantitative limit on the fire load. The rule is to limit the quantities of combustible materials to what is strictly necessary for normal operations, and lower than values taken into account in the safety demonstration.

**Silo 130**

See previous answer

**Osiris**

The CEA fire risks management study rules indicate two classification criteria based on the fire load density of a study system which enables to define the level of analysis :

* 1080 MJ/m²,
* 600 MJ/m² adjacent to a study system containing a target (SSC, etc.)

If a criterion is exceeded, a specific level of analysis is required.

The first criterion comes from the regulation applicable to a type of French nuclear defense facilities (article 30 of the decree of Septembre 26, 2007) which indicates that if a room exceeds a fire load density of 1200 MJ/m² it is necessary to justify the fire resistance of this room. This limit is taken into account in the CEA study rules by considering a safety margin of 10%.

The second criterion is linked to a French regulatory requirement that initially concerns high-rise buildings.

**UNGG**

The fire loads criteria PFG, PFL and non-PFL used are detailed in "Analysis method" (p23). In order to characterise the fires to be studied, “the identification, location, concentration and nature of combustible masses are taken into account”. These criteria are established using principles similar to those expressed in the Annex A of the standard ISO 18195. Refer also to Annex A of the standard ISO 18195 for further details.

Are they justified knowing that fires in nuclear facilities are generally under-ventilated?

**Tricastin**

The PFG, PFL and non-PFL criteria are considered in the new method for justification of sectorisation PEPSSI, which considers the under-ventilated nature of rooms. The method is based on an approach involving both the realistic growth of a fire in a semi-confined environment and the actual performance of the sectorisation equipment. Refer to "New method for justification of sectorisation" (p25) and standard ISO 18195 for further details.

For fire risks analyses in which modelling tools are used, the under-ventilated nature of rooms is considered.

**Framatome Romans**

See previous answers.

Yes, the under-ventilated fire is taken into account, notably in calculations that can be made for cases when the assessment of the designed fire resistance of a compartment is deemed necessary.

**MELOX**

Absolutely, the quantitative limits are no longer justified because of the under-oxygenation of the fires.

**Silo 130**

See previous answer

**Osiris**

As previously answered, the fire resistance rating of fire compartment depends on fire scenario and not only on the fire load density. The fact that fires in nuclear facilities are generally under-ventilated has no impact on these criteria.

**UNGG**

The PFG, PFL and non-PFL criteria are considered in the new method for justification of sectorisation PEPSSI, which considers the under-ventilated nature of rooms. The method is based on an approach involving both the realistic growth of a fire in a semi-confined environment and the actual performance of the sectorisation equipment. Refer to "New method for justification of sectorisation" (p25) and standard ISO 18195 for further details.

For fire risks analyses in which modelling tools are used, the under-ventilated nature of rooms is considered.

## Qualification of cables: As far as qualified cables (typically FRNC) are available, in how far are they taken into account as fire load and fire source? How is the qualification of those cables been considered in the fire analysis and for what objective? In how far are protected cables (e.g., protected by protective coatings) considered as contributors to fire propagation in the fire analysis?

**Tricastin**

“The reference scenarios consider all the fuels present”. Note that “fuels” here do not refer to nuclear fuel but only to flammable loads. “Fuels” include all the qualified cables as fire load. Refer to “Scenarios” (p20) for further details.

In addition, for deterministic studies “the presence of an ignition source is postulated”. “The initial outbreak of fire is thus supposed to be able to occur whatever the nature, quantity, type and configuration of the combustible masses present”, these masses include cables as an ignition source. Refer to "Location of the fire" (p20) for further details.

The qualification of cables in terms of fire reaction is considered in the analyses, as the modelling of fire cables is based on correlations established on qualified cables. Refer to ISO 18195 on cable correlations.

The contribution to fire of cables that are fire-protected by a qualified protection is not considered and the combustible load is assumed to be null.

**Silo 130**

Under current regulations, cables must comply with class C1, defined by the decree of July 21, 1994 from the point of view of their reaction to fire. Thus, a cable falling under class C1 does not spread fire. However, in the event that it is technically impossible to install electrical cables conforming to this class, the operator justifies the use of another class. In fact, such cables classified C1 present in particular less flexibility.

Besides being a regulatory requirement, this interesting classification with regard to the propagation of a fire is not valued in the estimation of heat loads. In fact, the heat load of the cables is retained in monitoring the heat load densities of the premises. This approach is therefore envelope.

In accordance with current regulations, all combustible materials in a premises are considered to analyze the risks linked to fire. This approach does not take into account the C1 classification of the cables.

Under the fire risk treatment methodology, cables may be subject to thermal protection in addition to their C1 classification. These protections aim for a two-hour fire rating qualification. Under this provision, such cables are kept unaffected by a fire and in any event, non-propagating.

**Osiris**

In FSA, the fire reaction qualification of cables is credited as a limitation of fire spread (defence in depth approach). Nevertheless, fire load of cables is taken into account. Furthermore, without any particular justification, electrical cables are supposed to be a fire source (short circuit in the event of damage to the insulation of the electrical cable, overload which could lead to an overheating, etc.).

Regarding aging BNI, some cables does not have high fire reaction performances. Therefore, for each modification, cables with adequate fire reaction performance are set up and old cables removed as far as possible.

It is possible to set up means to limit the fire linear spread on cables. Nevertheless, without qualified fire-resistant protection, it is not possible to credit in the FSA the fact that the cables fire load and fire source are not taken into account.

**UNGG**

“The reference scenarios consider all the fuels present”. Note that “fuels” here do not refer to nuclear fuel but only to flammable loads. “Fuels” include all the qualified cables as fire load. Refer to “Scenarios” (p20) for further details.

In addition, for deterministic studies “the presence of an ignition source is postulated”. “The initial outbreak of fire is thus supposed to be able to occur whatever the nature, quantity, type and configuration of the combustible masses present”, these masses include cables as an ignition source. Refer to "Location of the fire" (p20) for further details.

The qualification of cables in terms of fire reaction is considered in the analyses, as the modelling of fire cables is based on correlations established on qualified cables. Refer to ISO 18195 on cable correlations.

The contribution to fire of cables that are fire-protected by a qualified protection is not considered and the combustible load is assumed to be null.

## Transient combustibles and ignition sources: In how far and how have transient combustibles and ignition sources (by e.g. hot works) been included in the fire analysis and what are the hypotheses related to their inclusion?

**Tricastin**

With regards to ignition sources, as described in "Location of the fire" (p20), “fire is postulated to occur inside the installation, in any room of the plant regularly containing or designed to regularly contain combustible materials. The presence of an ignition source is postulated: the initial outbreak of fire is thus supposed to be able to occur whatever the nature, quantity, type and configuration of the combustible masses present.”

With regards to permanent storage, as described in “A-I-3.1.1 Design considerations and prevention means” (p91), “Permanent storage areas are planned for at the design stage”, and the associated fire loads and risk of ignition is considered in specific fire risk analyses.

With regards to temporarily stored fire loads, as described in “A-I-3.1.1. Design considerations and prevention means” (p91), “Temporary storage places for the fire loads, and their storage capacities, are determined in advance as part of the operating procedures (comprising the baseline requirements for fire load management and sectorization management), but were not taken into account at the design stage”.

Additionally, as described in “A-I-3.1.3.3. Overview of actions and implementation status” (p95), “EDF is currently looking into ways of improving this topic, based on the principle of bringing the conditions of application of the temporary fire load storage rules in line with the DMRI, according to the reference state of each plant unit. The approach is based on using the available fire studies to identify the possibilities of temporary storage of fire loads in premises that do not call into question the conclusions of these studies. These temporary storage possibilities shall be interlinked with the recurrent needs identified by the licensee and implemented by sharing the best practices available and/or already applied by the sites. They shall be defined with the aim of adapting the means used to the risks (temporary storage prohibited in certain sensitive places, restriction of the quantities or nature of the fire loads stored, setting up appropriate compensatory means, etc.).

In this context, EDF is developing a methodology which aims to use the fire studies to identify temporary storage possibilities within the premises for all the plant units.”

**RHF**

See answer to question FR-E-802 generic.

**Framatome Romans**

See paragraph II-2.3.2 of the report.

**MELOX**

An envelope value for the temporary fire load is determined for each type of room. This value is added to the permanent fire load to represent the overall fire load of the room. This fixed value takes into account the potential occurrence of several usual operations at the same time. The fire load associated with exceptional works are assessed specifically.

Hot work is subject to an authorization procedure detailing the risk analyzes and the protection measures to be taken into account.

**Pool D - T0**

Monitoring the heat load of premises exclusively takes into account the characteristics of combustible materials present in a permanent manner in a premises. Conditioning is therefore not taken into account. For example, for an electrical cabinet, a heat load is assigned but this value does not take into account the fact that the release of energy associated with this calorific potential is different depending on whether the doors of this cabinet are closed or open . The approach therefore penalizes that the doors are open even though they must be kept closed as part of good practices and safety rules. Furthermore, as mentioned previously, the raw value of the calorific potential reflects the available energy which would be released during combustion in an open environment. The confined and under-ventilated aspect of the premises of the nuclear workshops also determines the release of the energy of a possible fire which develops there.

Concerning transitory combustible materials, a logistical approach is also adopted to manage the presence of such materials over a short period of time. For example, it is prescribed to only supply consumables useful for the workstation or the task in order to minimize combustible material. Consequently, a collection of good practices reminds, for example, not to store combustible materials below an electrical box otherwise, to maintain an isolation distance. In the same way, this standard highlights the usefulness of disposing of the waste produced during an intervention, otherwise, packaging it, for example, in a closed metal container. The same goes for the equipment brought. These simple modalities have the advantage of being understandable to all those involved. They are considered as such to be a good practice allowing the integration of hazards linked to human factors and thus reducing the associated risk. These simple measures allow the best possible and operational link with the safety demonstration.

Finally, in the context of projects implemented for the need for a modification, an analysis is carried out within the framework of a “work authorization”. Hot spot operations are a transient ignition source and as such, a fire permit is drawn up. A “Works Office” organizes all the interventions that must be carried out within a building and systematically carries out the expected analyses. In the case of fire permits, a prevention visit makes it possible to identify the dangers of the operation and the points of vulnerability linked to the construction site. Consequently, to protect against the risks thus identified, prevention, monitoring and protection measures are defined. Responsibility for their implementation is agreed jointly with the works manager, also and above all including the site monitoring phase. A worker comes to check during the first half-day that the planned measures are being applied. The objective is to maintain the demonstrative framework in the long term by introducing compensatory measures.

**Silo 130**

Monitoring the heat load of premises exclusively takes into account the characteristics of combustible materials present in a permanent manner in a premises. Conditioning is therefore not taken into account. For example, for an electrical cabinet, a heat load is assigned but this value does not take into account the fact that the release of energy associated with this calorific potential is different depending on whether the doors of this cabinet are closed or open. The approach therefore penalizes that the doors are open even though they must be kept closed as part of good practices and safety rules. Furthermore, as mentioned previously, the raw value of the calorific potential reflects the available energy which would be released during combustion in an open environment. The confined and under-ventilated aspect of the premises of the nuclear workshops also determines the release of the energy of a possible fire which develops there.

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## Transient combustibles and decommissioning activities: In how far and how have risks from transient combustibles and decommissioning activities (ignition sources by e.g. hot works) been included in the fire analysis and what are the hypotheses related to their inclusion?

**Osiris**

The assessment of fire loads per room has included fixed and transient fire loads which are taken into account by the fire risk management study. Transient fire loads include storage areas (nuclear waste, etc.) and all fire loads needed for generic decommissioning activities (plastic decommissioning airlocks, etc.). On top of that, corresponding fire scenarios (including fire sources such as hot-spot works) have been taken into account by FSA.

Due to the daily fluctuation fire load due to operating requirements, an additional safety margin of 10% was taken into account by the FSA. This value represents the reference fire load, not to be exceeded. The absence of exceeding the reference fire load is verified by periodic inspections of the rooms. In the event of an excess, an action plan is implemented.

Before specific decommissioning activities, specific fire safety analyzes are also carried out. These analyzes take into account transient fire loads of the corresponding activities. The absence of excess at the reference fire load is verified. Otherwise, an additional analysis is carried out which can lead to compensatory measures if necessary.

In the event of hot-spot works, a hot work permit is delivered for the specific operation.

**UNGG**

EDF applies the same methodology for BNI 46 as for Tricastin (see the EDF responses for Tricastin). For BNI 46, in particular, the ignition sources and/or heat loads contributed by the decommissioning activities are taken into account in the scenarios postulated in a deterministic manner by EDF.

## Direct fire effects: Are direct fire effects (either by smoke, pressure, temperature, soot, etc) onto SSCs important to safety considered in the fire analysis (including reliability of human actions, fire pressure effects on fire doors, fire overpressure effects on cascade flow and pressure gradients of the dynamic confinement system, …)? Some detailed information about the regulatory requirements applicable and the way such effects are taken into account regarding design/conception/construction/modifications would be appreciated.

**Tricastin**

The effects of fire considered in the fire analyses are detailed in multiple sections. Refer in particular to "Analysis method" (p20), "New method for justification of sectorisation" (p25), "Effects induced by smoke from fire" (p25), "Pressure effects induced by the fire" (p25), "Re-ignition of unburned gases in the ventilation ducts" (p26), "Impact of a fire on systems carrying hydrogenated fluids (flame jet)".

**Silo 130**

Under current regulations, all the effects of a fire must be considered.

In terms of example, redundancies of elements important for protection are analyzed. Protections as close as possible to these elements are therefore favored to best deal with all the vectors of aggression.

**Osiris**

Direct fire effects must be considered in the FSA in relation to the vulnerability of SSCs or the activities needed to reach and maintain a safe state (e.g. possibilty to carried out an action to shut down nuclear ventilation).

These effects must be taken into account using a macroscopic and qualitative approach which can be supplemented by a detailed and quantitative analysis with a qualified and adapted tool for modeling fire effects.

The regulatory requirement on this topic is indicated by article 4.4.25 of the ASN’s decision no. 2015-DC-0532.

In the event of modifications, the estimation of these effects enables to define the adequate fire resistance performance of fire protection means (e.g. an « S » criterion is necessary or not concerning the fire resistance performance of a fire damper depending on whether or not the limitation of smoke flow is credited by the FSA).

**UNGG**

The effects of fire considered in the fire analyses are detailed in multiple sections. Refer in particular to "Analysis method" (p20), "New method for justification of sectorisation" (p25), "Effects induced by smoke from fire" (p25), "Pressure effects induced by the fire" (p25), "Re-ignition of unburned gases in the ventilation ducts" (p26), "Impact of a fire on systems carrying hydrogenated fluids (flame jet)".

## Electrical fires: Have electrically induced fires (including fires by high-energy arcing faults, HEAF) been considered in the fire analyses?

**Tricastin**

HEAF is not considered in deterministic fire analyses, but from a fire PSA perspective.

**Osiris**

The FSA’s deterministic approach systematically involves a fire start due to an electrical source.

**UNGG**

HEAF is not considered in deterministic fire analyses, but from a fire PSA perspective.

## Fire Brigade: How have the response times of the fire brigade (onsite, offsite brigades) been taken into account in the fire analysis? This question is more relevant in those installations that do not have a dedicated onsite fire brigade.

**Tricastin**

As described in « Role of on-site and off-site fire-fighting” (p29), “fire-fighting is based on an organisation capable of carrying out the actions needed to respond to the fire, pending the arrival of the off-site emergency resources. It is not however included in the safety case.”

The off-site fire brigade is not directly credited in the deterministic fire safety demonstration but brings robustness to the approach. As such, the responses times of the on-site and off-site fire brigades are not relevant to the demonstration. However, these times are evaluated for instance for personnel safety as well as for investment protection purposes.

Similarly, the on-site fire brigade is not directly credited in the deterministic fire safety demonstration but brings robustness to the approach.

**RHF**

See NAR § B 3.2.3.2 "Firefighting capabilities, responsabilities, organization and documentation onsite and offsite" and answer to question FR-E-857 generic.

**Silo 130**

As a reminder, the establishment has a barracks located on the site and which is equipped with intervention equipment. This barracks is similar to that of a town of 30,000 inhabitants. It is made up of five brigades of 30 members each operating on a 24x72 schedule, reinforced during the day by one of the two teams posted in 2x8s each composed of 9 people.

The second intervention team may be required to intervene to manage various situations in a radiological environment such as a fire, chemical pollution, victim assistance or also an intervention of a physical protection nature. The particularity of this emergency center dedicated to the establishment is therefore to provide teams of firefighters specialized in dealing with possible risks in basic nuclear installations. This organization is a real strength because the establishment's intervention teams are able to intervene as quickly as possible, 24 hours a day. An order of magnitude of time following the alert with a view to an intervention carried out by the second intervention team internal to the site is indicated in the Internal Emergency Plan (PUI) of the establishment, namely of the order 25 minutes.

By comparison, the main emergency center closest to the establishment is that located in Cherbourg-en-Cotentin, approximately 30 kilometers away. The estimated travel time without any hassle due to road traffic, works, etc. is approximately 30 minutes. However, a fire station with a total staff of around 40 firefighters is also located in the town of Beaumont-Hague, less than 5 km away.

**Osiris**

The CEA Saclay nuclear site benefits from an on-site fire brigade. Considering the exercices feedback, the time nedeed to implement a first fire hose in a building of BNI 40 (OSIRIS) would reasonably be expected to be lower than 30 minutes. That is why fire risk management study considers the establishment of a first fire hose within a reasonable period of 30 minutes without necessarily relying on the effectiveness of the intervention for demonstration. This response time for the establishment of a first fire hose by the on-site fire brigade is only credited in the FSA as a defence in depth mean of fire protection. The response time of off-site brigades is not credited in the FSA.

An analysis is carried out specifically to ensure fire risk management in areas presenting difficulties for emergency intervention (presence of high voltage etc.).

**UNGG**

As described in « Role of on-site and off-site fire-fighting” (p29), “fire-fighting is based on an organisation capable of carrying out the actions needed to respond to the fire, pending the arrival of the off-site emergency resources. It is not however included in the safety case.”

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Similarly, the on-site fire brigade is not directly credited in the deterministic fire safety demonstration but brings robustness to the approach.

## Radiological consequences of fires: Please provide more details about the methods of addressing the radiological consequences of the fires in the fire analysis and the radiological criteria of acceptance and the corresponding threshold values applicable.

**Tricastin**

As described in “Other common mode studies” (p28), “the acceptability of the radiological consequences of hazards of internal origin, including fire, was determined and the conclusions of the studies were able to demonstrate the acceptability of the radiological consequences of the hazards with regards to the targeted objectives of the RP4 900.”

In general, the purpose of assessing the radiological consequences of hazards is to justify their acceptability in relation to the dose limits associated with the design basis operating conditions.

Based on bounding scenarios, the aim is to check that the potential radiological consequences are below the dose limits defined for the design basis operating conditions having a frequency of occurrence in the same range.

**RHF**

See answer to question FR-C-208 specific ILL.

## Radiological/criticality consequences: Please provide description for:

Assessment of radiological consequences of a fire in the analysis and criteria and corresponding threshold values applicable in the success criteria.

**Framatome Romans**

See paragraph II-2.3.3 of the report.

**MELOX**

The assessment of radiological consequences takes into account the quantity of nuclear materials, their resuspension factor by fire, the effectiveness of filtration systems. The acceptability of radiological consequences is determined by comparison with the general safety objectives: public exposure less than 1 mSv for incidental or accidental situations, exposure less than 10 mSv for accidental design situations. The regulatory thresholds for public protection decisions are: 10 mSv for sheltering, 50 mSv for evacuating the population.

**Silo 130**

The approach to evaluating the radiological impact was deduced from the R&D tests making it possible to estimate the combustion kinetics.

In addition, this approach made it possible to confirm as a success criterion, the operational maintenance of the last level of filtration in connection with the resuspension of the magnesia.

The second success criterion established is the effectiveness of the argon extinguishing system.

Installation-wide containment of a fire situation in silo 130 is therefore confirmed.

Methodology of assessment of the radiological consequences of a fire in the analysis and criteria and corresponding threshold values applicable in the success criteria.

**Osiris**

In order to assess the radiological consequences of a fire, the activity released to the environment is determined thanks to the use of a reasonably conservatism concerning the radiological activity involved in the corresponding fire scenario. The application of coefficients which depend on the nature of the impacted substances (radioactive activated steel, contaminated plastic waste etc.), the fraction placed in suspension of the radionuclides considered, the leak fraction (only static barriers have been credited in the BNI 40 studies) are taken into account by the radiological impact assessment. The radiological consequences for the public are then evaluated using a CEA code at different distances, at different age groups of the population and under different weather conditions and for several exposure durations.

For each scenario studied, the results of the assessment were then compared to the doses associated with the intervention levels (10 mSv for sheltering populations and 50 mSv for evacuation) defined for the public in the decree of November 20, 2009 approving decision no. 2009-DC-0153 of the Authority of nuclear safety of August 18, 2009 and the marketing limits defined in Euratom Regulation No. 2016/52 of the Council of January 15, 2016 setting the maximum admissible levels of radioactive contamination for foodstuffs and animal feed after a nuclear accident or in any other radiological emergency situation.

The results of the assessments carried out on BNI 40 (Osiris) showed that the maximum doses were lower than those associated with the intervention levels defined for the public and that the activities added to foodstuffs would be lower than the marketing limits.

For every accidental scenario occurring during the decommissioning of BNI 40 (Osiris), the radiological consequences are not significant.

**UNGG**

As described in “Other common mode studies” (p28), “the acceptability of the radiological consequences of hazards of internal origin, including fire, was determined and the conclusions of the studies were able to demonstrate the acceptability of the radiological consequences of the hazards with regards to the targeted objectives of the RP4 900.”

In general, the purpose of assessing the radiological consequences of hazards is to justify their acceptability in relation to the dose limits associated with the design basis operating conditions.

Based on bounding scenarios, the aim is to check that the potential radiological consequences are below the dose limits defined for the design basis operating conditions having a frequency of occurrence in the same range.

Radiological confinement measures during a fire.

**Framatome Romans**

See paragraphs II-2.3.3, C-II-3.3.1, C-II-3.3.2 and C-II-3.3.3 of the report. Data developed in C-II-3.3.1, C-II-3.3.2 and C-II-3.3.3 are part of the fire safety analysis. Radiological containment is based on passive (walls, buildings…) and dynamical (ventilation) provisions. In fire situation the dynamical containment is maintained as long as possible, as explained in paragraph C-II-3.3.2.

**MELOX**

Measures relating to radiological containment during a fire predict:

* Integrity of the filtration systems on the exhaust ventilation network from the burning room (temperatures, pressure differences, chimney discharge rate);
* Verification of the absence of contamination outside the fire and containment sector;
* Measurement of chimney discharges (activity, flow rate).

**Osiris**

The answer to this question is already available in chapter F-I-3.3.2 of the French national report.

The operations to be carried out by the personnel to manage radiological containment in fire situation are detailed in a specific procedure (e.g. shutting down the nuclear ventilation and closing of the hatchway in connection with the environment).

**UNGG**

The physical confinement intrinsic to the installation is not taken into account in the assessment of radiological consequences. For example, THE filters are present at the last levels of ventilation filtration, but their filtration is not taken into account, in a penalising way, in the assessments of the radiological consequences of accidental situations.

Criticality: How has the criticality aspect been taken into account in the analysis and the impact on the fire protection features.

**Framatome Romans**

See paragraphs II.2.3.4, C-II-3.2.2.2, C-II-3.2.2.3 and C-II-3.2.3.1 of the report. In addition, the criticality risk is assessed in the Fire Risk Analysis wherever the risk is present in case of fire. Recommendations can subsequently be made, e.g. protection of metallic structures, increase of physical distance, etc. as outcome of the analysis.

**MELOX**

In the criticality accident risk analysis, sensitive rooms considering the presence of hydrogenated fluids are identified. In the event of a fire in one of these rooms, the use of water or foam to extinguish is prohibited. The humidity level in powder extinguishers is limited. The extinguishing systems are with carbon dioxide.

How have the radiological hazards (radiological, criticality) been taken into account in the development of the fire brigade procedures (onsite, offsite brigades)?

**Framatome Romans**

See paragraph C-II-3.2.3.1 of the report.

**MELOX**

MELOX firefighters are trained in the specific risks of the installation. If the assistance of an external brigade is necessary, the command of operations remains under the authority of the MELOX intervention manager.

## Analytical methods:

For the installations that do not provide enough detail on the tools and models used in the fire analysis, please provide a more detailed description.

**Tricastin**

Details on the tools and models used in the fire analyses are provided in "Fire phenomena analyses - Overview of models, data and consequences" (p30).

**Framatome Romans**

See paragraph II-2.3.3 of the report. For zone code, we use the CFAST model, and for CFD we used the STAR-CCM+ code.

**MELOX**

Fire development scenarios inside a closed or semi-open volume are modeled using the CFAST calculation code. This is a zone code developed by NIST (National Institute of Standards and Technology) which can predict the effects of the development of a fire and the resulting smoke layer inside a volume with the hypothesis of stratified flows.

Fire scenarios requiring turbulence and heat exchanges to be taken into account (particularly at walls, outlets or doors) are modeled using the FDS (Fire Dynamics Simulator) calculation code. This is a field codes developed by NIST (National Institute of Standards and Technology) which are suitable for fire simulation in buildings.

Structure stability assessment calculations are carried out using the SAFIR calculation code. This code is used for the study of structures in fire ; it can evaluate the behavior of a structure at high temperature with calculation of heat transfers in the different components.

**Silo 130**

The approach to treating fire risks is deterministic.

For the case of silo 130, only a calculation approach was implemented for the sizing of the argon extinguishing system. Its effectiveness was evaluated by verifying the reduction in oxygen levels within the expected time frame.

**Osiris**

The main tools and models used in the FSA of BNI 40 (OSIRIS) regarding the direct effects of fire (hot gas temperature, etc.) are the fire models developed by NIST such as:

* CFAST (Consolidated Model of Fire and Smoke Transport),
* FDS (Fire Dynamics Simulator).

A CEA model is used to assess radiological effects (atmospheric transfert, etc.).

**UNGG**

Details on the tools and models used in the fire analyses are provided in "Fire phenomena analyses - Overview of models, data and consequences" (p30).

In cases where computational tools have been used within fire safety analyses, provide information on the sensitivity and uncertainty analyses carried out.

**Tricastin**

With regards to the computational tools, as described in "Additional studies and sensitivities" (p29), “the codes are used within their validity range (Scientific Computing Tool). Management of uncertainty for the deterministic numerical studies is generally based on the use of penalizing hypotheses.”

With regards to sensitivity analyses in fire safety analyses, refer for example to “Aggravating factors (WENRA)” (p26) and "Additional studies and sensitivities" (p29).

**Framatome Romans**

See paragraph II-2.3.3 of the report. The uncertainties are defined in the checking and validation documents of the code used. They are taken into account in the analysis of the results.

In addition, sensitivity analyses are made, notably to identify the most unfavourable situation(s), provided they remain realistic, e.g. variation of the nature of the combustible materials, of the fire location in the room, failure of a protection device (door, fire damper).

**MELOX**

The fire scenarios modeled in the CFAST or FDS calculation codes are deliberately chosen to determine by the model the most penalizing effects. The uncertainties are then largely covered by the hypotheses taken in the scenarios.

**Osiris**

No sensitivity analysis was carried out when computational tools were used within the FSA. Expert use of computational tools ensures that assumptions have been selected with an appropriate conservative approach focusing on the effects to be assessed and on the vulnerabiliy of targets (e.g. fire and target distance, fraction placed in suspension based on the physical state of radionuclides, etc.).

**UNGG**

With regards to the computational tools, as described in "Additional studies and sensitivities" (p29), “the codes are used within their validity range (Scientific Computing Tool). Management of uncertainty for the deterministic numerical studies is generally based on the use of penalizing hypotheses.”

With regards to sensitivity analyses in fire safety analyses, refer for example to “Aggravating factors (WENRA)” (p26) and "Additional studies and sensitivities" (p29).

The use of calculation tools is growing. What are your review processes to identify the needs and advantages/disadvantages of adopting such tools? What are the outcomes of these prospects?

**Tricastin**

There is currently no formal review process to identify advantages/disadvantages of adopting calculations tools. EDF has developed tools to perform calculations that were done manually before (e.g. MAGIC zone model), these tools are therefore adapted to EDF needs.

However, “Scientific Computing Tools” are associated with a qualification file to establish the suitability of these tools within a defined validity range, which is generally obtained by comparison with experimental tests.

How are you facing to this (understanding of the corresponding studies by the stakeholders)?

**Tricastin**

See previous answer.

## Management of temporary modifications and their impact on fire safety: A lot of temporary modifications are implemented at research reactors for performing experiments. These temporary modifications for experiments may increase fire loads in compartments, limit access to compartments or buildings, or even impact sequences of fire events if any. Could you please specify:

Are, and how are the modifications (including those for incorporation of new experimental devices, launching new laboratories, etc.) considered in the fire safety analysis and the periodic safety review (PSR) updates?

Is any fire safety analysis/assessment of temporary modification for experiments conducted before implementation (to assess the impact on the fire safety of the reactor)?

Updates of the FSA and PSR: criteria and periodicity for their review.

**RHF**

See NAR B 3.1.1: The modification process "catches up" every kind of modification leading to a significant change in the Fire analysis, even if temporary. As a matter of fact,the Fire Risk analysis data sheet indicates, depending on the order of magnitude of fire load increase, if a simple work authorization is needed (for temporary modification <60 days) or if a Modification application form is needed ( if the fire load limits are exceeded and if the modification is permanent).

Sources to derive new modifications: FSA and PSR and their updates, operating experience, new regulation, etc.

**RHF**

Yes of course.

## Operating Experience: Provide a detailed description on if and how the operating experience from both (i) fires and (ii) other events (whether reportable or not) with degradation or failure of fire protection features in the installation analysed –and, as far as available, also from other nuclear installations– is considered in the fire analysis.

**Tricastin**

Refer to “I-2.1.6.2. Lessons learned from events, reviews, fire safety related missions, etc.” (p33) for further details on how EDF has considered operational experience in fire analyses.

Additionally, fire events are considered in fire PSA studies to assess the probability of an incipient fire.

**Framatome Romans**

Every abnormal event on the site is registered in a database, as mentioned in paragraph C-II-3.1.3.2. Depending on the level of the event, a detailed cause analysis can be made, leading to improvements deployed. In addition, as mentioned in paragraph C-II-3.1.3.1, the site is a partner of the inter-licensee working group on the fire theme, and a Framatome fire community was created. As described in paragraph II-2.3.5.1, the ten-yearly periodic safety reviews include a safety reassessment which takes account of experience feedback, relating notably fire risk.

**MELOX**

When developing the periodic safety review, a review of MELOX operating experience is carried out. This assessment is supplemented by the analysis of national and international events at other nuclear installations. If necessary, an improvement action plan is defined.

**Pool D - T0**

Pool D and this type of installation have not been the subject of any feedback from an event that led to the deterioration or failure of fire protection systems.

For the analysis of the accumulation of independent events, the probabilities of the "outbreak of fire" and "developed fire" events are established on the basis of the REX events relating to the Orano La Hague site.

The probability of a fire starting depends on the ignition sources present in the room.

The probability of a "developed fire" varies according to whether or not the premises is classified as a fire zone (highest probability of occurrence).

The combination of a fire with the failure or unavailability of a fire protection system is taken into account in demonstrating control of fire-related risks (failure of a detection system, etc.) and in assessing the radiological consequences in the event of a fire (late extinguishing, etc.).

**Silo 130**

The framework of silo 130 is very specific and only benefits from feedback linked to the event that occurred in 1981. The root cause of the event could not be fully attested. To compensate for this aspect, a specific R&D process was carried out to refine the understanding of the phenomenology of the risks linked to fire inherent in the waste contained in silo 130. Assessments of the aggression of the last level of filtration were carried out and the argon extinguishing system was designed accordingly.

The waste recovery activity from silo 130 has started and is satisfactory because the first feedback does not report any events.

**Osiris**

An international feedback analysis was carried out in the fire risk management study of BNI 40 (OSIRIS) in order to highlight relevant practices for operations similar to those to be carried out during the decommissioning phase of BNI 40 (OSIRIS). The recommendations resulting from this analysis were taken into account and implemented in the FSA.

**UNGG**

Refer to “I-2.1.6.2. Lessons learned from events, reviews, fire safety related missions, etc.” (p33) for further details on how EDF has considered operational experience in fire analyses.

Additionally, fire events are considered in fire PSA studies to assess the probability of an incipient fire.

## Additional analyses: Following the accident at the Fukushima NPP, stress tests were defined for European NPP. Has there been followed a similar approach regarding beyond-design-basis fire events for nuclear power plants in your country?

**Tricastin**

The "beyond-design basis" approach is not deemed to be appropriate for internal fires. This is considering that the internal fires are limited by the combustible present (no possibility to burn more combustible, in case of a “beyond-design basis” approach).

This is different for natural external hazards. With regards to the robustness against Safe Shutdown Earthquake (SSE), refer to the verification studies carried out on fire protection measures, for example in “A-I-3.2.2.2. Types, main characteristics and performance expectations” (p137), “A-II- 1300 MWe & N4 series passive fire protection concept and its implementation” (p208) and “A-II- 1300 MWe & N4 series active fire protection concept and its implementation” (p144).

##  Additional analyses: Please provide details about:

Following the accident at the Fukushima NPP, stress tests were defined for European NPP. Has there been followed a similar approach regarding beyond-design-basis fire events for spent fuel storage facilities in your country?

**Pool D - T0**

The post-Fukushima additional safety studies concern only external hazards. However, Orano La Hague's crisis management reference framework includes PUI reference scenarios involving internal fires (solvent fire, etc.). Accident situations aggravated by induced fires are also considered under hard core situations with the existence of mitigation means (fire in silos 115 and 130).

With regard to Pool D, the results show that the integrity of the Pool's structure has been maintained in the face of natural hazards greater than the initial design, none of which would lead to a fire scenario. The remedial measures taken would ensure that staff could intervene in the building in the event of a fire.

Some countries mention that a periodic safety review is performed for spent fuel storage facilities. It would be good to know more on the applicability and frequency of PSR for such facilities in your country in order to identify potential strengths.

**Pool D - T0**

A periodic review of the installations is carried out every 10 years, including a safety reassessment of the risks in the light of developments in the state of the art, new knowledge and feedback from experience.

## Results of the Fire Safety Analyses, revisions and actions: Please provide details about:

A more elaborated description of the results of the analysis since for some plants the description is not very detailed.

**Tricastin**

The main results of the analyses are provided in the relevant sections. For instance on Tricastin, refer to “New method for Justification of sectorization” (p25), “Effects induced by smoke from fire” (p25), “Pressure effects induced by the fire” (p25), “Re-ignition of unburned gases in the ventilation ducts” (p26), “Impact of a fire on systems carrying hydrogenated fluids (flame jet” (p26), “Aggravating factor (WENRA)” (p26), “Operator Intervention times” (p27), “Other common mode studies” (p28).

Please provide results for the fire contribution to CDF / LRF / LERF.

**Tricastin**

As described in “Fire PSA” (p29) and “RP2 N4” (p36), the risk of core melt associated with the fire hazard (corresponding to Level 1 fire PSA) is about 10-6 for the 900 Mwe series and 10-5 for the N4 series.

The process carried out to update the fire analysis and the reasons for that.

**Tricastin**

Fire safety analysis can be performed or updated in the context of periodic safety reviews. Refer to “I-2.1.5. Periodic review and management of changes” (p30) for further details.

As an example, additional studies were performed as part of the 4th Periodic Safety Review of the 900 MW plant series. Refer to “Additional studies performed as part of the 4th Periodic Safety Review of the 900 MW plant series” (p24).

The procedure and responsibilities to design and establish compensatory measures when non-conformities or weaknesses have been identified.

**Tricastin**

Refer to “A-I-3.2.2.4. Alternative/temporary provisions” (p139) for details on the compensatory or complementary measures considered in case the fire protection system is partially or totally unavailable.

Additionally, note that following fire safety analyses, additional protection provisions and / or operational measures are implemented where relevant. For instance as described in “New method for Justification of sectorization” (p25), “Following these studies, EDF is therefore implementing additional protection provisions, for example: cable protections, replacement or addition of fire doors, reinforcement of Fire sectorization elements in the pump house, fire protection reinforcement of “passive protection” type sectorization elements. EDF is also implementing operational measures to reduce the heat load in certain rooms identified as rooms with safety implications.”

The use of the fire analyses by the regulator.

**Tricastin**

The fire analyses are watched by ASN and IRSN (its TSO) during periodic safety reviews and a technical dialogue takes place.

Inspections can be made by the regulator to check if the hypotheses considered are met.

The influence of international reviews on the Fire Safety Analysis.

**Tricastin**

International reviews with peers (e.g. WANO, OSART) are mostly focused on operational aspects, related to the implementation of the fire protection concept in the installations: the detection of fire, the activation of the fire protection, maintenance and periodic tests, operational experience.

In general, EDF is active in international events and seminars dedicated to fire protection and safety. Additionally, EDF is involved in a number of international associations (e.g. AFCEN, ENISS), which allows EDF’s approach in terms of Fire Safety Analyses to be benchmarked against international peers practices to ensure that any relevant good practices is taken into account appropriately.

EDF also participates to joint R&D projects related to fire (e.g. EPRI projects, OECD/NEA/CSNI projects such as HEAF and PRISME).

## Results and revisions of the Fire Safety Analyses, additional analyses: Please provide details about:

Treatment of modifications and changes in the installations as well as updates of the analysis should be addressed.

**Framatome Romans**

See paragraphs II-2.3.5.1 et II-2.3.5.2 of the report. See also paragraph II-2.3.2.

**MELOX**

Installation modifications are subject of an authorization request (internal to the BNI or external to the nuclear safety authority). The fire risk analysis can be completed on this occasion. The safety demonstration is at least subject to reassessment during the periodic safety review every 10 years.

The process carried out to update the fire analysis.

**Silo 130**

The process of updating the analysis of fire-related risks is that of the safety review, scheduled every ten years. Apart from this approach, only the occurrence of an event would justify a reassessment of risk management at silo 130.

**Osiris**

At the very least, FSA is updated every ten years, at the time of each nuclear safety periodic review. Throughout the life of a BNI, additional studies may also be carried out if necessary. This was recently the case for BNI 40 (OSIRIS). Three additional studies were carried out for the commissioning of new nuclear waste storage areas, the installation of a waste cutting shear and the commissioning of a new mechanical workshop.

**UNGG**

Fire safety analysis can be performed or updated in the context of periodic safety reviews. Refer to “I-2.1.5. Periodic review and management of changes” (p30) for further details.

As an example, additional studies were performed as part of the 4th Periodic Safety Review of the 900 MW plant series. Refer to “Additional studies performed as part of the 4th Periodic Safety Review of the 900 MW plant series” (p24).

Following the accident at the Fukushima NPP, stress tests were defined for European NPP. Has there been followed a similar approach regarding beyond-design-basis fire events for fuel fabrication facilities in your country?

**Framatome Romans**

This question calls for an answer at national level. As mentioned in the document, Framatome Romans complies with the regulations and standards in effect.

Since the Fukushima NPP accident, as the other French nuclear operators, the Site has conducted a *Complementary Safety Assessment* and associated actions mandated by the French regulation.

**MELOX**

During the stress tests, MELOX did not identify a fire scenario bringing the installation into a situation like during the accident at Fukushima.

Following the accident at the Fukushima NPP, stress tests were defined for European NPP. Has there been followed a similar approach regarding beyond-design-basis fire events for waste storage facilities in your country?

**Silo 130**

During the occurrence of a strong earthquake, the maintenance of the watertightness of silo 130 cannot be demonstrated but the latter would still ensure containment of the waste.

An ECS scenario is established for silo 130 for which the sending of water is retained despite the pyrophoric nature of certain waste. This possibility has been demonstrated. The water supply comes from an independent external source using mobile pumping means stored in a secure manner.

Following the accident at the Fukushima NPP, stress tests were defined for European NPP. Has there been followed a similar approach regarding beyond-design-basis fire events for facilities under decommissioning in your country?

**Osiris**

No similar approach has been followed in the FSA field concerning a BNI under decommissioning in CEA. However, the conservatism of the hypotheses of certain scenarios envisaged by the FSA of BNI 40 (e.g. widespread fire over an entire area of the installation) enables to analyze and conclude on the acceptability of scenarios with a very low level of probability.

**UNGG**

Following the Fukushima accident, additional safety assessments were also carried out on the NPPs being dismantled. These assessments focused on the analysis of extreme natural phenomena, in addition to the sizing of the means of protection against these types of hazard, and on the robustness of the means of managing potential accident situations.

Some countries mention that a periodic safety review is performed for waste storage facilities. It would be good to know more on the applicability and frequency of PSR for such facilities in your country in order to identify potential strengths.

**Silo 130**

As mentioned previously, the periodicity of a safety review is ten years. Its advantage is to be able to periodically reconsider the risks linked to fire, allowing regulatory developments and feedback to be taken into account.

Some countries mention that a periodic safety review is performed for decommissioning facilities. It would be good to know more on the applicability and periods of performance of PSR for such facilities in your country in order to identify potential strengths.

**Osiris**

French regulations (article L. 593-18 of the Environment Code) indicate that a periodic safety review must be carried out with a minimum frequency of ten years.

**UNGG**

As with all nuclear facilities in France, nuclear facilities undergoing decommissioning are required to submit a safety review every 10 years. This report includes a safety reassessment section and a compliance review section. It takes into account regulatory changes, future operations and feedback from experience.

## Strengths/weaknesses: In cases that no strengths and weaknesses have been explicitly mentioned in the NAR, please confirm that neither strengths nor weaknesses have been identified."

**Tricastin**

Strengths and weaknesses have been identified, refer to “I-2.1.6.1. Overview of strengths and weaknesses identified” (p32) and “I-2.1.7.1. Overview of strengths and weaknesses identified by the regulator” (p33) for further details.

**Framatome Romans**

Strengths/weaknesses are mentioned in paragraphs II-2.3.6.1, C-II-3.1.3.1, C-II-3.2.4.1 and C-II-3.3.3.1.

**MELOX**

MELOX only mentioned in the NAR the information deemed relevant on the strengths and weaknesses of the BNI.

**Pool D - T0**

As mentioned in the report, the approach which aims to standardize the minimum level of risk control provisions has been completed. Regulatory developments have led to strengthening the typology of premises identified in the design. This approach therefore makes it possible to generalize the same minimum fire protection provisions for the same dangerous situation.

These developments also make it possible to compensate for the weakness of the design based solely on heat load thresholds below which no provision was made.

Finally, during ten-yearly reviews, a visit to each premises is carried out in order to confirm and concretely assess the function of the premises, the nature of the danger and the presence of safety targets. Feedback from field visits carried out during safety reviews shows that this is good practice.

**Silo 130**

As mentioned in the report, all useful feedback was consolidated following an event that occurred in 1981. A specific R&D process was carried out to better understand the phenomenology of combustion occurring within the waste from silo 130. In addition, a dedicated argon extinguishing system was installed and its triggering mode was reinforced by automating it in conjunction with automatic fire detection.

**Osiris**

The strengths and weaknesses are described in the French national report.

**UNGG**

Strengths and weaknesses have been identified, refer to “II-2.6.6.1. Overview of strengths and weaknesses identified” (p89) and “II-2.6.7.1. Overview of strengths and weaknesses identified by the regulator” (p90) for further details.

# Fire prevention/passive fire protection

## Management of fire loads

Describe the types of permanent and transient fire loads in the facilities?

**Tricastin**

The types of permanent and transient fire loads are described in “A-I-3.1.1 Fire prevention – Prevention means” an A-I-3.1.2 “Overview of arrangements for management and control of fire load and ignition sources” (p76).

The permanent storage areas are planned for at the design stage. Temporary storage places for the fire loads, and their storage capacities, are determined in advance as part of the operating procedures (comprising the baseline requirements for fire load management and sectorisation management), but were not taken into account at the design stage.

Areas for the permanent and temporary storage of equipment and combustible materials are necessary for the functioning of the sites. The permanent storage areas have undergone a verification study as part of the Fire Risks Management Case (DMRI). It is mandatory to check their conformity every 3 months. The temporary storage areas are subject to a layout study and validation by the entity in charge of packing, assisted by the risk prevention department. In both cases the quantities of combustible materials present are limited to the strict minimum necessary.

It is prohibited to store anything in the access fire zones, in the protected horizontal passageways, reception areas and staircases. The predetermined, occasional and worksite temporary storage areas are subject to written justification of their duration and the need, to a risk analysis and are limited in duration to three months maximum per user and per zone.

**RHF**

Types of loads are described in the Fire loads data sheets which are the entry data for Fire risk analysis sheets elaborated for each room in the perimeter of the FSA. The fire load considered in fire load data sheet is envelope and includes margins for temporary additional fire loads. Only In the reactor building, while reactor in operation, new packaging material and wooden material are forbidden.

**GB II**

Permanent fire loads are fixed equipments, paints, electric cables ; transient fire loads are mobiles equipments, waste.

**UP3A-T2**

Permanent heat loads, commonly encountered in premises, are essentially electrical equipment (electrical cabinets and boxes, radiation protection control boxes, cable trays) but also storage of technological waste in generally metallic drums or finally, stores or shelves of consumables (rolls of vinyl, intervention clothing, gloves, etc.). More specifically, in the process rooms, the heat load is also made up of dedicated equipment (containment enclosure, electric motors, reagent storage tanks, ventilation unit, etc.). Temporarily, the heat loads associated with these phases consist of consumables and some waste produced before collection.

**MELOX**

The types of the permanent fire loads are:

* Paints on walls and floors, coverings, combustible separation elements, …
* Non mobile equipment (office automation, electrotechnical equipment, glove boxes, biological protection panels, …)

Transient fire loads consist of operating consumables (materials, protective equipment, etc.) and maintenance consumables (equipments, airlocks, waste drums, etc.).

**Pool D - T0**

Permanent heat loads, commonly encountered in premises, are essentially electrical equipment (electrical cabinets and boxes, radiation protection control boxes, cable trays) but also storage of technological waste in generally metallic drums or finally, stores or shelves of consumables (rolls of vinyl, intervention clothing, gloves, etc.). More specifically, in the process rooms, the heat load is also made up of dedicated equipment (containment enclosure, electric motors, reagent storage tanks, ventilation unit, etc.). Temporarily, the heat loads associated with these phases consist of consumables and some waste produced before collection.

**Silo 130**

Permanent heat loads, commonly encountered in premises, are essentially electrical equipment (electrical cabinets and boxes, radiation protection control boxes, cable trays) but also storage of technological waste in generally metallic drums or finally, stores or shelves of consumables (rolls of vinyl, intervention clothing, gloves, etc.). More specifically, in the process rooms, the heat load is also made up of dedicated equipment (containment enclosure, electric motors, reagent storage tanks, ventilation unit, etc.). Temporarily, the heat loads associated with these phases consist of consumables and some waste produced before collection.

**Osiris**

The main fire loads are waste generated by decommissioning operations (transient), cables insulation (permanent), electrical and electrotechnical equipments (mainly permanent), plastic decommissioning airlocks (transient), trucks (gasoline) and forklifts (transient).

**UNGG**

The types of permanent and transient fire loads are described in “F-II-3.1.1 Design considerations and prevention means” and F-II-3.1.2 “Overview of arrangements for management and control of fire load and ignition sources” (p131).

The permanent storage areas are planned for at the design stage. Temporary storage places for the fire loads, and their storage capacities, are determined in advance as part of the operating procedures (comprising the baseline requirements for fire load management and sectorisation management), but were not taken into account at the design stage.

Areas for the permanent and temporary storage of equipment and combustible materials are necessary for the functioning of the sites. The permanent storage areas have undergone a verification study as part of the Fire Risks Management Case (DMRI). It is mandatory to check their conformity every 3 months. The temporary storage areas are subject to a layout study and validation by the entity in charge of packing, assisted by the risk prevention department. In both cases the quantities of combustible materials present are limited to the strict minimum necessary.

It is prohibited to store anything in the access fire zones, in the protected horizontal passageways, reception areas and staircases. The predetermined, occasional and worksite temporary storage areas are subject to written justification of their duration and the need, to a risk analysis and are limited in duration to three months maximum per user and per zone.

How is the inventory of fire loads (transitional and permanent) systematically documented (e.g. computer system) and managed (tasks and responsibilities) during operation and decommissioning (if any what is the difference)?

**Tricastin**

Management of the fire loads in permanent or temporary storage is governed by operating baseline requirements, refer to §A-I-3.1.2 (p76) for further details.

The principles put in place (risk analysis, restriction of quantities, compensatory means, etc.) aim to avoid calling into question the conclusions of the fire studies associated with the reference state of each plant unit.

It is prohibited to store anything in the access fire zones, in the protected horizontal passageways, reception areas and staircases. The predetermined, occasional and worksite temporary storage areas are subject to written justification of their duration and the need, to a risk analysis and are limited in duration to three months maximum per user and per zone.

As an example, regarding permanent storage :

- is the subject of implementation studies by design engineering and validation by the entity in packing,

supported by the risk prevention department,

- is identified, in the heat load management (SI) tools,

- is externally displayed in the storage areas, where the envelope inventory of the products present and potential risks,

- is subject to controls that relate to :

o compliance with the maximum heat load,

o accessibility to response teams,

o Accessibility of extinguishing equipment

Regarding temporary storage, the details are described in “A-I-3.1.2 Fire prevention – Prevention means” (p76).

**RHF**

More than 100 Room Responsibles have been trained to daily management of fire risk. Particularly, they have to make sure that their environment complies with the data shown on Fire Risk Data Sheet Fire Loads Data sheet of the room. For rooms exhibiting "significant risk", the Fire Risk data sheet is posted at the entrance of the Room. For reactor building a procedure prohibits the entrance of any packaging or wooden material during reactor cycle.

**GB II**

Fire loads are listed and checked in a computer system. When safety target is located, this inventory is periodically updated. Fire loads managment is study in § C-I-3.1.2.

**UP3A-T2**

For all accessible premises (except red zones), a computer application monitors the heat load represented by the equipment permanently present in a premises. This monitoring allows us to position ourselves in relation to values serving as benchmarks, to recommend the implementation of various protections against fire risks. In addition, the presence of important elements for the safety of the installation, the existence of an important axis of intervention for establishing and maintaining a safe state, etc. are also other elements taken into account. taken into consideration when assessing the need. For example, heat load evaluations also include wall coverings in a penalizing manner but exclude non-combustible equipment even if in theory, they can restore post-event thermal energy ( refractory behavior). This consideration aims to analyze the nature, location and conditioning of this heat load with regard to the environment in which it will be placed.

**MELOX**

The fire load values per room are recorded in a database. Only a few authorized people from the fire protection department can update it.

This inventory is updated whenever modifications are subject of an authorization request (internal or external). The modification manager determines the changes in permanent fire loads due to his work.

For transient loads, an envelope value for temporary heat loads is determined by type of rooms. In the database, this fixed value is added to the permanent fire load to represent the overall fire load of the room. A periodic check of the rooms ensures that there is no deviation.

**Pool D - T0**

For all accessible premises (except red zones), a computer application monitors the heat load represented by the equipment permanently present in a premises. This monitoring allows us to position ourselves in relation to values serving as benchmarks, to recommend the implementation of various protections against fire risks. In addition, the presence of important elements for the safety of the installation, the existence of an important axis of intervention for establishing and maintaining a safe state, etc. are also other elements taken into account. taken into consideration when assessing the need. For example, heat load evaluations also include wall coverings in a penalizing manner but exclude non-combustible equipment even if in theory, they can restore post-event thermal energy (refractory behavior). This consideration aims to analyze the nature, location and conditioning of this heat load with regard to the environment in which it will be placed.

**Silo 130**

For all accessible premises (except red zones), a computer application monitors the heat load represented by the equipment permanently present in a premises. This monitoring allows us to position ourselves in relation to values serving as benchmarks, to recommend the implementation of various protections against fire risks. In addition, the presence of important elements for the safety of the installation, the existence of an important axis of intervention for establishing and maintaining a safe state, etc. are also other elements taken into account. taken into consideration when assessing the need. For example, heat load evaluations also include wall coverings in a penalizing manner but exclude non-combustible equipment even if in theory, they can restore post-event thermal energy (refractory behavior). This consideration aims to analyse the nature, location and conditioning of this heat load with regard to the environment in which it will be placed.

**Osiris**

The management of fire loads in BNI 40 (Osiris) is described in § F-I-3.1.2. A file including the inventory of fire loads is carried out for each room of BNI 40 (OSIRIS). This file is updated periodically, and if there are significant changes in fire loads due to remediation work, decommissioning or reconfiguration of the installation. In this context, a transient fire load analysis is carried out prior to any major work.

**UNGG**

Management of the fire loads in permanent or temporary storage is governed by operating baseline requirements, refer to §F-II-3.1.2 (p131) for further details.

The principles put in place (risk analysis, restriction of quantities, compensatory means, etc.) aim to avoid calling into question the conclusions of the fire studies associated with the reference state of each plant unit.

It is prohibited to store anything in the access fire zones, in the protected horizontal passageways, reception areas and staircases. The predetermined, occasional and worksite temporary storage areas are subject to written justification of their duration and the need, to a risk analysis and are limited in duration to three months maximum per user and per zone.

As an example, regarding permanent storage:

- is the subject of implementation studies by design engineering and validation by the entity in packing,

supported by the risk prevention department,

- is identified, in the heat load management (SI) tools,

- is externally displayed in the storage areas, where the envelope inventory of the products present and potential risks,

- is subject to controls that relate to :

o compliance with the maximum heat load,

o accessibility to response teams,

o Accessibility of extinguishing equipment

Regarding temporary storage, the details are described in “F-II-3.1.2 Design considerations and prevention means” (p131).

How is analysed whether the change on fire loads affects fire risk?

**Tricastin**

The analysis of the fire loads added to the installation is based on:

- The justification of the need that validates the need to introduce these heat loads inside the facilities

- The comparison of the maximum added heat load justified with the limit values defined, by zone, in the Fire Risk Control Demonstration.

The analysis is therefore systematically carried out by comparing the requirement with the maximum permissible values. In this sense, variations in heat loads maintained at levels below the limits justified in the demonstration of fire risk control do not affect the fire risk level chosen for the area.

**RHF**

Through the Modification authorization process when the fire loads exceed the limits authorized in the Fire load data sheets and Fire Risk Analysis data sheets.

**GB II**

The modifications management process includes an analysis of the potential changes of fire loads.

**UP3A-T2**

In addition, on a daily basis, for transient combustible materials, a logistical approach is adopted to manage the presence of such materials over a short period of time. For example, it is prescribed to only supply consumables useful for the workstation or the task in order to minimize combustible material. Consequently, a collection of good practices reminds, for example, not to store combustible materials below an electrical box otherwise, to maintain an isolation distance. In the same way, this standard highlights the usefulness of disposing of the waste produced during an intervention, otherwise, packaging it, for example, in a closed metal container. The same goes for the equipment brought. These simple modalities have the advantage of being understandable to all those involved. They are considered as such to be a good practice allowing the integration of hazards linked to human factors and thus reducing the associated risk. These simple measures allow the best possible and operational link with the safety demonstration.

In the event of a modification in a room, the impact of the heat load is calculated and analyzed. This analysis mainly concerns the nature, location and conditioning of this heat load with regard to the environment in which it will be placed. Any additional provisions are put in place based on the analysis.

**MELOX**

When examining the installation modification request, the fire and safety specialists check whether the fire load thresholds (defined by type of rooms) have been reached, requiring an in-depth analysis. When necessary, the in-depth analysis examines the flammability of the products, the risk of fire propagation, the extinguishing provisions, sectorization and even the potential radiological consequences.

**Pool D - T0**

In addition, on a daily basis, for transient combustible materials, a logistical approach is adopted to manage the presence of such materials over a short period of time. For example, it is prescribed to only supply consumables useful for the workstation or the task in order to minimize combustible material. Consequently, a collection of good practices reminds, for example, not to store combustible materials below an electrical box otherwise, to maintain an isolation distance. In the same way, this standard highlights the usefulness of disposing of the waste produced during an intervention, otherwise, packaging it, for example, in a closed metal container. The same goes for the equipment brought. These simple modalities have the advantage of being understandable to all those involved. They are considered as such to be a good practice allowing the integration of hazards linked to human factors and thus reducing the associated risk. These simple measures allow the best possible and operational link with the safety demonstration.

In the event of a modification in a room, the impact of the heat load is calculated and analyzed. This analysis mainly concerns the nature, location and conditioning of this heat load with regard to the environment in which it will be placed. Any additional provisions are put in place based on the analysis.

**Silo 130**

In addition, on a daily basis, for transient combustible materials, a logistical approach is adopted to manage the presence of such materials over a short period of time. For example, it is prescribed to only supply consumables useful for the workstation or the task in order to minimize combustible material. Consequently, a collection of good practices reminds, for example, not to store combustible materials below an electrical box otherwise, to maintain an isolation distance. In the same way, this standard highlights the usefulness of disposing of the waste produced during an intervention, otherwise, packaging it, for example, in a closed metal container. The same goes for the equipment brought. These simple modalities have the advantage of being understandable to all those involved. They are considered as such to be a good practice allowing the integration of hazards linked to human factors and thus reducing the associated risk. These simple measures allow the best possible and operational link with the safety demonstration.

In the event of a modification in a room, the impact of the heat load is calculated and analyzed. This analysis mainly concerns the nature, location and conditioning of this heat load with regard to the environment in which it will be placed. Any additional provisions are put in place based on the analysis.

**Osiris**

Fire loads modifications (assessed for operations or observed during surveys) are examined in relation to reference fire loads. If the reference fire loads is exceeded, an analysis is systematically carried out and an action plan implemented.

**UNGG**

The analysis of the fire loads added to the installation is based on:

- The justification of the need that validates the need to introduce these heat loads inside the facilities

- The comparison of the maximum added heat load justified with the limit values defined, by zone, in the Fire Risk Control Demonstration.

The analysis is therefore systematically carried out by comparing the requirement with the maximum permissible values. In this sense, variations in heat loads maintained at levels below the limits justified in the demonstration of fire risk control do not affect the fire risk level chosen for the area.

How is the existing knowledge of the inventory used during daily activities?

**Tricastin**

The permanent and temporary storage areas are all identified locally. A display allows you to list the important elements of the site permit. Maximum inventories are systematically displayed in type and quantity of materials and equipment. All maintenance and operations agents are regularly trained to comply with these limitations.

**GB II**

Equipments are located in the facilities with visual identification.

**UP3A-T2**

See previous answer

**MELOX**

For daily transient loads, an envelope value for temporary fire loads is determined by type of rooms.

**Pool D - T0**

See previous answer

**Silo 130**

See previous answer

**Osiris**

Daily activities do not call into question the reference fire loads. These activities have been considered and adequate margins have been taken into account for the reference fire loads determination.

However, when exceptional operations are carried out, a specific analysis is realised to assess the fire load involved and to determine its acceptability in terms of fire risk management.

As previously answered, periodic inspections of the rooms ensure that the reference fire loads are not exceeded.

On top of that, monthly safety inspections (not only focused on fire loads) are realised in BNI 40 (OSIRIS) and enable to check fire loads management.

**UNGG**

The permanent and temporary storage areas are all identified locally. A display allows you to list the important elements of the site permit. Maximum inventories are systematically displayed in type and quantity of materials and equipment. All maintenance and operations agents are regularly trained to comply with these limitations.

What are the limits and practices on permanent and transient loads, which items are excluded?

**Tricastin**

Management of the fire loads in interim storage is governed by operating baseline requirements.

Several rules are set out on the justification of fire loads, these set exclusions and prohibitions by nature and location, refer to §A-I-3.1.2 for further details:

* hazardous products (including flammable products) are subject to special management rules and are not allowed in generic storage and storage. In the same vein, equipment supplied with energy or connected to the installation is not allowed in storage and warehousing, it is analysed as an activity generating the implementation of specific countermeasures.

It is prohibited to store anything in the access fire zones, in the protected horizontal passageways, reception areas and staircases. The predetermined, occasional and worksite temporary storage areas are subject to written justification of their duration and the need, to a risk analysis and are limited in duration to three months maximum per user and per zone.

**RHF**

The fire load considered in fire load data sheet is envelope and includes margins for temporary additional fire loads

**GB II**

cf. § C-I-3.1.2. : The fire load in the rooms containing safety targets to the maintained in case of fire is limited by design to the functioning of the process. When conducting works, the fire load is limited to the strict minimum with only the equipment necessary for the work present.

**UP3A-T2**

The "5S" approach developed by the Orano establishment in La Hague involves visits to the premises at a frequency depending on various parameters such as the attendance rate or the possible locking of the premises. The objective is to visually verify whether the observed state corresponds to its environment in normal operation and that the equipment present is correctly positioned in the planned locations. These periodic checks are the responsibility of the operating teams. Any anomaly is reported to management for treatment.

**MELOX**

Combustible materials contained in envelopes or containers made of fire-resistant or non-combustible materials are considered non-mobilizable in the event of a fire.

**Pool D - T0**

The "5S" approach developed by the Orano establishment in La Hague involves visits to the premises at a frequency depending on various parameters such as the attendance rate or the possible locking of the premises. The objective is to visually verify whether the observed state corresponds to its environment in normal operation and that the equipment present is correctly positioned in the planned locations. These periodic checks are the responsibility of the operating teams. Any anomaly is reported to management for treatment.

**Silo 130**

The "5S" approach developed by the Orano establishment in La Hague involves visits to the premises at a frequency depending on various parameters such as the attendance rate or the possible locking of the premises. The objective is to visually verify whether the observed state corresponds to its environment in normal operation and that the equipment present is correctly positioned in the planned locations. These periodic checks are the responsibility of the operating teams. Any anomaly is reported to management for treatment.

**Osiris**

As previously explained, the fire load is determinated by taking into account permanent and transient fire loads representatives of the operating requirements of the BNI. Afterwhat an additional margin of 10% is systematically taken into account and represents the fire loads reference.

Exceptional operations benefit from their own FSA, and deal with the risk linked to the evolution of fire load. In this case, if necessary, compensatory measures can be defined.

**UNGG**

Management of the fire loads in interim storage is governed by operating baseline requirements.

Several rules are set out on the justification of fire loads, these set exclusions and prohibitions by nature and location, refer to §F-II-3.1.2 for further details:

* hazardous products (including flammable products) are subject to special management rules and are not allowed in generic storage and storage. In the same vein, equipment supplied with energy or connected to the installation is not allowed in storage and warehousing, it is analysed as an activity generating the implementation of specific countermeasures.

It is prohibited to store anything in the access fire zones, in the protected horizontal passageways, reception areas and staircases. The predetermined, occasional and worksite temporary storage areas are subject to written justification of their duration and the need, to a risk analysis and are limited in duration to three months maximum per user and per zone.

Describe the inspection programme for fire loads, roles and (independent) responsibilities and frequency. What are the lessons learned and corrective actions taken?

**Tricastin**

Systematic checks are carried out at frequencies specific to the added fire load family. These are quarterly checks by the owner department and annual by the storage risk prevention department. Weekly checks by owners for storage. The national level of supervision follows an indicator on the number of compliant storage on the number of storage monitored at the monthly frequency. Refer to §A-I-3.1.2 for further details.

Lessons learned and overview of actions are described in “§ A-I-3.1.3.2” (p77-78).

**RHF**

See answer to question FR-C-211: More than 100 Room Responsibles have been trained to daily management of fire risk. Particularly, they have to make sure that their environment complies with the data shown on Fire Risk Data Sheet and Fire Loads Data sheet of the room (with special attention to fire load limit). For rooms exhibiting "significant risk", the Fire Risk data sheet is posted at the entrance of the Room.

For reactor building a procedure prohibits the entrance of any packaging or wooden material during reactor cycle.

**GB II**

cf. § C-I-3.1.2 : The licensee regularly monitors the operating fire load present in the rooms through monthly patrols intended to detect any anomaly (storage of unauthorised material, presence of waste, leaks of liquid, etc.).

The lessons learned could be to add an extinguisher and corrective actions are to put in order.

**UP3A-T2**

See previous answer.

**MELOX**

Periodic (weekly) rounds ensure that there is no deviation in the rooms. Inspections or audits make it possible to verify the application of the process by sampling during the exploitation. During periodic ten-year safety reviews, an update of the inventory is carried out by sampling over a perimeter of chosen rooms.

**Pool D - T0**

See previous answer.

**Silo 130**

See previous answer.

**Osiris**

The fire loads inspection program is specified in § F-I-3.1.2. and carried out by BNI 40 (OSIRIS) employees or by a specialized subcontractor under the supervision of the BNI 40 (OSIRIS). External controls, known as second-level inspections, may be carried out by the CEA site's nuclear safety unit on behalf of the director of the CEA Saclay site, and inspections on this topic may be carried out by the Nuclear Safety Authority (ASN).

Lessons learned and corrective actions taken are for instance remove of unnecessary fire loads, implementation of this deviations to carry out a new FSA and eventually set up corresponding compensatory measures.

**UNGG**

Systematic checks are carried out at frequencies specific to the added fire load family. These are quarterly checks by the owner department and annual by the storage risk prevention department. Weekly checks by owners for storage. The national level of supervision follows an indicator on the number of compliant storage on the number of storage monitored at the monthly frequency. Refer to §F-II-3.1.2 for further details.

Lessons learned and overview of actions are described in “§ F-II-3.1.3.2” (p132).

## Management of ignition sources

What types of hot works are managed in the installations? What are the roles and responsibilities and the way they are regulated and listed?

**Tricastin**

EDF always issues "hot work permits" for all hot work operations that could cause an incipient fire. A Fire Prevention Guide identifies the main works requiring the implementation of the fire permit system and the different countermeasures that can be used and their framework of use: grinding, plasma arc cutting, welding torch, …

These hot work permits are applicable throughout hot work execution and are subject to prior preparation, notably through a specific risk analysis which is systematically checked and recorded by the service in charge of risk prevention and validated by the licensee.

The works supervisor, whose presence is mandatory during the execution phase, does not authorise hot work to start until a hold point has been lifted by authorised personnel, as close as possible to the start of work. The lifting of this hold point serves to ensure that the conditions set out in the risk analysis concerning the environment and the conditions of activity performance are satisfied and that the planned protective measures are effectively in place.

All hot work is conditional upon obtaining a hot work permit, which is valid when the validation circuit and the prior verifications have been performed correctly. The hot work permit is specific to a given activity and place and its validity cannot exceed 5 days.

A fire permit is a regulatory requirement in NBIs for "hot spot" work (Chapter 2.3. of Decision 2014-DC-0417) and as part of the prevention plan under the Labour Regulation. In the context of hot spot work, the risk of fire increases, and requires a precise analysis of the situation (location, site environment, activity to be carried out) in order to define the countermeasures Adapted. The purpose of preparing the fire permit is to formalize the assessment of these risks before the execution of the work and define the necessary countermeasures. Validation is carried out after checking the adequacy of the analysis risks with the intervention environment. Refer to “management and control of fire load and ignition sources” § A-I-3.1.2 (p76) for further details.

The fire permit:

- is prepared by the entity in charge of preparing the activity (project manager, preparer, etc.),

- is validated by the risk prevention department and the operator,

- is issued by the Director of Unit or his/her delegate,

- is taken care of by the works manager, who signs it,

- is validated by the risk prevention department as part of the "lifting of the stopping point" as close as possible to the start of the activity by hot spot, in order to check that the countermeasures are in place and that the environment of the site is consistent with the fire permit issued,

The works manager:

- implements the measures set out in its fire permit,

- does not start its activity by hot spot until the stop point of the fire permit has been lifted, - ensures continuous monitoring of the area concerned by possible detection inhibition fire, and informs the control room each time it leaves the site to ensure the handover in the operation of the fire detection,

- keeps the fire permit for the duration of its work, in order to be able to present it at a control

- submits the fire permit to the department responsible for risk prevention for archiving at the end of the work

**GB II**

cf. § C-I-3.1.2 : Hot work (welding, grinding, cutting, etc.) must be authorised by a hot work permit issued by the licensee. It includes a prior analysis of the fire risk created by the type of work and the work environment and prescribes the measures to take to control this risk when performing the work (setting up protective screens, fire extinguishers suitable for the class of fire, etc.). This people are designated and listed.

**UP3A-T2**

Concerning hot spot work, these are implemented for the need of a modification. On the basis of an analysis carried out within the framework of a "work authorization", a fire permit is drawn up. All types of hot spot work can be carried out but the most commonly seen are grinding and welding or cutting operations. A “Works Office” organizes all the interventions that must be carried out within a building and systematically carries out the expected analyses. In the case of fire permits, a prevention visit makes it possible to identify the dangers of the operation and the points of vulnerability linked to the construction site. Consequently, to protect against the risks thus identified, prevention, monitoring and protection measures are defined. The objective is to maintain the demonstrative framework in the long term by introducing compensatory measures. Responsibility for their implementation is agreed jointly with the works manager, also and above all including the site monitoring phase. A worker comes to check during the first half-day that the planned measures are being applied.

**MELOX**

Hot work requires a fire permit. This involves welding, cutting by chainsaw, sanding, thermal stripping, … and all work using equipment that generates flame, heat or sparks.

The independent specialist fire service analyzes fire permit applications and defines the necessary protection measures. The works manager puts in place the required protection measures. The sector manager authorizes the start of work.

**Pool D - T0**

Concerning hot spot work, these are implemented for the need of a modification. On the basis of an analysis carried out within the framework of a "work authorization", a fire permit is drawn up. All types of hot spot work can be carried out but the most commonly seen are grinding and welding or cutting operations. A “Works Office” organizes all the interventions that must be carried out within a building and systematically carries out the expected analyses. In the case of fire permits, a prevention visit makes it possible to identify the dangers of the operation and the points of vulnerability linked to the construction site. Consequently, to protect against the risks thus identified, prevention, monitoring and protection measures are defined. The objective is to maintain the demonstrative framework in the long term by introducing compensatory measures. Responsibility for their implementation is agreed jointly with the works manager, also and above all including the site monitoring phase. A worker comes to check during the first half-day that the planned measures are being applied.

**Silo 130**

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**Osiris**

The main type of hot works concerns cutting or welding operations. Hot-spot works are subject to hot work permits (see roles and responsibilities below).

**UNGG**

EDF always issues "hot work permits" for all hot work operations that could cause an incipient fire. A Fire Prevention Guide identifies the main works requiring the implementation of the fire permit system and the different countermeasures that can be used and their framework of use: grinding, plasma arc cutting, welding torch, …

These hot work permits are applicable throughout hot work execution and are subject to prior preparation, notably through a specific risk analysis which is systematically checked and recorded by the service in charge of risk prevention and validated by the licensee.

The works supervisor, whose presence is mandatory during the execution phase, does not authorise hot work to start until a hold point has been lifted by authorised personnel, as close as possible to the start of work. The lifting of this hold point serves to ensure that the conditions set out in the risk analysis concerning the environment and the conditions of activity performance are satisfied and that the planned protective measures are effectively in place.

All hot work is conditional upon obtaining a hot work permit, which is valid when the validation circuit and the prior verifications have been performed correctly. The hot work permit is specific to a given activity and place and its validity cannot exceed 5 days.

A fire permit is a regulatory requirement in NBIs for "hot spot" work (Chapter 2.3. of Decision 2014-DC-0417) and as part of the prevention plan under the Labour Regulation. In the context of hot spot work, the risk of fire increases, and requires a precise analysis of the situation (location, site environment, activity to be carried out) in order to define the countermeasures Adapted. The purpose of preparing the fire permit is to formalize the assessment of these risks before the execution of the work and define the necessary countermeasures. Validation is carried out after checking the adequacy of the analysis risks with the intervention environment. Refer to “management and control of fire load and ignition sources” § F-II-3.1.2 (p131) for further details.

The fire permit:

* is prepared by the entity in charge of preparing the activity (project manager, preparer, etc.),
* is validated by the risk prevention department and the operator,
* is issued by the Director of Unit or his/her delegate,
* is taken care of by the works manager, who signs it,
* is validated by the risk prevention department as part of the "lifting of the stopping point" as close as possible to the start of the activity by hot spot, in order to check that the countermeasures are in place and that the environment of the site is consistent with the fire permit issued,

The works manager:

* implements the measures set out in its fire permit,
* does not start its activity by hot spot until the stop point of the fire permit has been lifted, - ensures continuous monitoring of the area concerned by possible detection inhibition fire, and informs the control room each time it leaves the site to ensure the handover in the operation of the fire detection,
* keeps the fire permit for the duration of its work, in order to be able to present it at a control
* submits the fire permit to the department responsible for risk prevention for archiving at the end of the work.

Describe the details of the approaches (as documented in procedures) to systemically permit and control hot works, including the types of additional (temporary) measures in fire prevention and firefighting. Is it different during decommissioning?

**Tricastin**

Refer to previous answers for details of the approaches to systemically permit and control hot works.

The permanent control carried out by the Works Manager on his work area, who must ensure or guarantee a permanent presence by designating a person to replace him in this task. Systematic inspection by an agent of the risk prevention department before the start of the work. The work cannot begin without this break-in period, which ensures that the entire situation is in accordance with the analysis and the defined countermeasures (Situation, environment, operations and planned means)

The "fire" theme rules applied on the Saint Laurent des Eaux site stem from the regulatory requirements, from the safety case and from the good practices stemming from acquired experience. These rules concern all the levels of defence in depth. The analysis of the events on sites undergoing dismantling shows that hot work is the leading cause of fire outbreaks. Such work requires preventive measures which are defined when the "hot work permit" is drafted. For each "hot work permit", the organisation in place provides for a risk analysis, defining of the associated countermeasures, various inspections and the responsibilities associated with the hot work. Refer to A-I-1.1.1 “Overview of arrangements for management and control of fire load and ignition sources” (p108).

**GB II**

See previous answer.

**UP3A-T2**

A documentary and training framework is developed (for installations in operation or dismantling) in order to raise awareness among the parties involved of the importance of properly handling these transient risky situations. Training is mandatory for all fire permit writers who can refer at any time to a very detailed guide to duly establish the expected risk analysis.

**MELOX**

Work authorizations are given by a sector manager, present nearby in the control room. When the type of work requires a fire permit, authorization can only be given once the fire permit has been issued. The specialized fire service issues a fire permit after analysis and verification that the protection measures have been taken into account.

**Pool D - T0**

A documentary and training framework is developed (for installations in operation or dismantling) in order to raise awareness among the parties involved of the importance of properly handling these transient risky situations. Training is mandatory for all fire permit writers who can refer at any time to a very detailed guide to duly establish the expected risk analysis.

**Silo 130**

A documentary and training framework is developed (for installations in operation or dismantling) in order to raise awareness among the parties involved of the importance of properly handling these transient risky situations. Training is mandatory for all fire permit writers who can refer at any time to a very detailed guide to duly establish the expected risk analysis.

**Osiris**

A hot work permit must be delivered for any hot-sport work. The person responsible for drawing up this permit realises a on-site visit with the person in charge of the hot work. They jointly carry out a fire safety analysis to define additional protective measures (prevention, monitoring and limitation of consequences). The permit is forwarded to the on-site fire brigade 48 hours before the hot work start. The procedures are the same during decommissioning.

**UNGG**

Refer to previous answers for details of the approaches to systemically permit and control hot works.

The permanent control carried out by the Works Manager on his work area, who must ensure or guarantee a permanent presence by designating a person to replace him in this task. Systematic inspection by an agent of the risk prevention department before the start of the work. The work cannot begin without this break-in period, which ensures that the entire situation is in accordance with the analysis and the defined countermeasures (Situation, environment, operations and planned means)

The "fire" theme rules applied on the Saint Laurent des Eaux site stem from the regulatory requirements, from the safety case and from the good practices stemming from acquired experience. These rules concern all the levels of defence in depth. The analysis of the events on sites undergoing dismantling shows that hot work is the leading cause of fire outbreaks. Such work requires preventive measures which are defined when the "hot work permit" is drafted. For each "hot work permit", the organisation in place provides for a risk analysis, defining of the associated countermeasures, various inspections and the responsibilities associated with the hot work. Refer to F-II-3.1.2 “Overview of arrangements for management and control of fire load and ignition sources” (p131).

Describe in some detail the programme of (independent) inspections related to hot works including the purpose (before, during, after the work).

**Tricastin**

Refer to previous answers for details of the program and “A-I-3.1.2” (p76) for further details.

**RHF**

For permanent activites, ignition sourcess are taken into account and managed though the Fire Risk Analysis data sheets. When it comes to ponctual works, work authorizations include a special «Fire permit" submitted to Safety group validation when works with "hot points" need to be carried out. Of course, this punctual risk analysis takes into account the presence (or not) of PIC's in the room.

**GB II**

cf. § C-I-3.1.2 : A surveillance patrol is carried out 2 hours after finishing the hot work to check there is not a smouldering fire.

**UP3A-T2**

In general, it is requested to extract from the intervention zone, all the equipment which can be evacuated, to provide an additional portable extinguishing means and to protect the equipment which could not be moved such as the paths of cables or other material present in the impact zone of the tools. Last but not least, it should be noted that the automatic fire detection system is generally not inhibited during work. In addition, after the end of the hot spot work, the work manager is asked to maintain a thirty-minute monitoring phase. In the absence of an automatic fire detection system, a surveillance round is planned; this is carried out either by the works manager or the operating teams.

**MELOX**

An analysis of the planned work is carried out before work by the specialized fire service, with the works manager, on the site of the intervention, to determine the necessary protection measures.

During the hot work, workers monitor their site. A check by the department responsible for the premises can be carried out.

After work and depending on the nature of the work, a check by the workers, completed by the specialized fire service, is carried out to check the absence of smoldering fire.

**Pool D - T0**

In general, it is requested to extract from the intervention zone, all the equipment which can be evacuated, to provide an additional portable extinguishing means and to protect the equipment which could not be moved such as the paths of cables or other material present in the impact zone of the tools. Last but not least, it should be noted that the automatic fire detection system is generally not inhibited during work. In addition, after the end of the hot spot work, the work manager is asked to maintain a thirty-minute monitoring phase. In the absence of an automatic fire detection system, a surveillance round is planned; this is carried out either by the works manager or the operating teams.

**Silo 130**

In general, it is requested to extract from the intervention zone, all the equipment which can be evacuated, to provide an additional portable extinguishing means and to protect the equipment which could not be moved such as the paths of cables or other material present in the impact zone of the tools. Last but not least, it should be noted that the automatic fire detection system is generally not inhibited during work. In addition, after the end of the hot spot work, the work manager is asked to maintain a thirty-minute monitoring phase. In the absence of an automatic fire detection system, a surveillance round is planned; this is carried out either by the works manager or the operating teams.

**Osiris**

During the hot work, fire detection is ensured by the operators, then a watch is kept for 2 hours after each intervention to detect any fire start. The monitoring (rounds) is specified in the hot work permit. In practice, at BNI 40 (OSIRIS), automatic fire detectors are generally not disabled during hot work operations. However, if it is necessary to inhibit the automatic fire detection, it is put back into operation at the end of the hot work.

**UNGG**

Refer to previous answers for details of the program and “F-II-3.1.2” (p131) for further details.

## Management of the hydrogen risk (not relevant for all facilities)

Describe all the elements of the management of hydrogen risk (such as limiting amount, separate storage, pipe routing etc….).

**Tricastin**

EDF has also studied the additional fire load risks associated with a hydrogen leak: failure of a component on a hydrogen network in the fire zone can effectively create an ignited jet of hydrogen, likely to temporarily increase the fire load (dihydrogen fire load) and thereby affect the fire sectorisation components present in the area of the jet. A modification is proposed to eliminate the risk of introducing hydrogen into premises with a high fire load in the event of fire. The solution consists in controlling the main valve of the hydrogen networks with the fire detection system: if fire is detected in the sensitive areas, the automatic system closes the valve and thereby stops the introduction of hydrogen into the lines that run through the fire zone.

Refer to I-2.1.2 “Key assumptions and methodologies” - Impact of a fire on systems carrying hydrogenated fluids (flame jet) (p19).

Refer to A-I-3.1.1 “Design considerations and prevention means” (p91).

The hydrogen risk (areas, batteries supplying electrical power to equipment situated,.. ) take into account in the explosion hazard in NPP’s : A specific approach to controlling the risk of explosion is implemented (explosion hazard).

**RHF**

One glass manufaturing workshop only on ILL premises uses on a permanently basis Hydrogen. This workshop is fully equiped with special piping and leak detectors (and obviously faire detectors as well). When hydrogen gaz bottles are needed for scientific experience, the risk analysis performed below to authorize the experience comprises the writing up of a special work instruction for reactor control room staff.

**GB II**

GBII hasn't hydrogen storage or hydrogen pipe routing.

**UP3A-T2**

Concerning the hydrogen risk, the risk linked to this gas as a reagent is not present in the T2 workshop. However, in such a case, the installation of gas cylinders is carried out outdoors. The ATEX regulatory approach is implemented and an isolation zone is defined.

**MELOX**

Compressed hydrogen cylinders are stored outside buildings. The hydrogen content of the argon – hydrogen gas mixture used in the manufacturing process is checked before transport to the manufacturing building. This content is below the flammability limit.

**Pool D - T0**

Concerning the hydrogen risk, the risk linked to this gas as a reagent is not present in the Pool D workshop. However, in such a case, the installation of gas cylinders is carried out outdoors. The ATEX regulatory approach is implemented and an isolation zone is defined.

**Silo 130**

Concerning the hydrogen risk, the risk linked to this gas as a reagent is not present in the Silo 130 workshop. However, in such a case, the installation of gas cylinders is carried out outdoors. The ATEX regulatory approach is implemented and an isolation zone is defined.

**Osiris**

The nuclear safety demonstration of BNI 40 (OSIRIS) demonstrated that the risk of H2 explosion can be excluded (the quantity of H2 possibly produced by radiolysis of water, NaK neutralization or by local batteries is very low).

**UNGG**

EDF has also studied the additional fire load risks associated with a hydrogen leak: failure of a component on a hydrogen network in the fire zone can effectively create an ignited jet of hydrogen, likely to temporarily increase the fire load (dihydrogen fire load) and thereby affect the fire sectorisation components present in the area of the jet. A modification is proposed to eliminate the risk of introducing hydrogen into premises with a high fire load in the event of fire. The solution consists in controlling the main valve of the hydrogen networks with the fire detection system: if fire is detected in the sensitive areas, the automatic system closes the valve and thereby stops the introduction of hydrogen into the lines that run through the fire zone.

Refer to II-2.6.2 “Key assumptions and methodologies” - Impact of a fire on systems carrying hydrogenated fluids (flame jet) (p22).

Refer to F-II-3.1.1 “Design considerations and prevention means” (p131).

The hydrogen risk (areas, batteries supplying electrical power to equipment situated,.. ) take into account in the explosion hazard in NPP’s : A specific approach to controlling the risk of explosion is implemented (explosion hazard).

Describe events and lessons learned or external experience used to modify the management of hydrogen and the related modifications.

**Tricastin**

Refer to previous answers for details to events and lessons learned or external experience used to modify the management of hydrogen and the related modifications.

**RHF**

No event.

**GB II**

GBII hasn't hydrogen storage or hydrogen pipe routing.

**UP3A-T2**

Concerning the hydrogen risk, the risk linked to this gas as a reagent is not present in the T2 workshop. However, in such a case, the installation of gas cylinders is carried out outdoors. The ATEX regulatory approach is implemented and an isolation zone is defined.

**MELOX**

The hydrogen content of the argon – hydrogen gas mixture used in the manufacturing process is controlled so as to maintain the hydrogen content to a level below the flammability limit. Lessons learned from events or external experience have not led MELOX to modify these management.

**Pool D - T0**

Concerning the hydrogen risk, the risk linked to this gas as a reagent is not present in the Pool D workshop. However, in such a case, the installation of gas cylinders is carried out outdoors. The ATEX regulatory approach is implemented and an isolation zone is defined.

**Silo 130**

Concerning the hydrogen risk, the risk linked to this gas as a reagent is not present in the Silo 130 workshop. However, in such a case, the installation of gas cylinders is carried out outdoors. The ATEX regulatory approach is implemented and an isolation zone is defined.

**Osiris**

The BNI 40 (OSIRIS) is not concerned by this question.

**UNGG**

Refer to previous answers for details to events and lessons learned or external experience used to modify the management of hydrogen and the related modifications.

## Compartmentation

**RHF**

See NAR §B 3.3.1 and §B 3.3.2 for details: no fire sector in ILL (except some rooms of ILL4 building,i.e: hostaging Reactor I&C and Alpha Laboratory inside the reactor building)

How is the risk taken into consideration?

**Tricastin**

The design approach and the description of fire compartments and/or cells design are descried are described in “A-I-3.3.1.1 and A-I-3.3.1.2 Prevention of fire spreading” (p167).

**Framatome Romans**

Our approach is given in paragraph C-II-3.3.1.1 of the report.

**UP3A-T2**

The design of the buildings is (except in special cases) in reinforced concrete and each building has a strong compartmentalization into premises which makes it possible to reduce the heat load within each of them by dividing it and already insulating it in a robust manner.

**MELOX**

French regulations define fire sector and containment sector. In MELOX, rooms are classified as fire sector when their fire loads exceed 400 MJ/m2.

**Pool D - T0**

The design of the buildings is (except in special cases) in reinforced concrete and each building has a strong compartmentalization into premises which makes it possible to reduce the heat load within each of them by dividing it and already insulating it in a robust manner.

**Silo 130**

The design of the buildings is (except in special cases) in reinforced concrete and each building has a strong compartmentalization into premises which makes it possible to reduce the heat load within each of them by dividing it and already insulating it in a robust manner.

**Osiris**

The answer to this question is available in chapter F-I-3.3.1 of the French national report.

**UNGG**

The design approach and the description of fire compartments and/or cells design are descried are described in “F-II-3.3.1.1 and F-II-3.3.1.2 Prevention of fire spreading” (p238).

How is propagation of fire prevented/delayed/mitigated?

**Tricastin**

The design approach and the description of fire compartments and/or cells design are descried are described in “A-I-3.3.1.1 and A-I-3.3.1.2 Prevention of fire spreading” (p167).

**Framatome Romans**

The elements are given in paragraphs C-II-3.3.1 and C-II-3.3.2 of the report.

**UP3A-T2**

More concretely, the functionality integrated into the premises can induce a high heat load or a vulnerability to be protected. Thus, fire-resistant surveillance and compartmentalization measures are implemented in order to isolate the potential danger or sensitive equipment. This type of protection when it is passive, applied in particular to elements important for establishing and maintaining a safe state, not only allows the failure of an active or maneuverable arrangement to be taken into account but also, integrate a real margin into the response time. For example, the installation of a two-hour passive fire protection protection on redundancies of power cables for backup of important elements allows the associated safety functions to be maintained at least during this time and this, without taking into account the beneficial effect of an intervention. These methods are a good practice in terms of safety and come as a variation of the regulations in force to make the demonstration more robust.

**MELOX**

The perimeter of rooms classified as fire sector is fire-rated to prevent a fire from spreading to neighboring premises. This fire protection design concerns walls, doors, dampers installed on ventilation networks.

**Pool D - T0**

More concretely, the functionality integrated into the premises can induce a high heat load or a vulnerability to be protected. Thus, fire-resistant surveillance and compartmentalization measures are implemented in order to isolate the potential danger or sensitive equipment. This type of protection when it is passive, applied in particular to elements important for establishing and maintaining a safe state, not only allows the failure of an active or maneuverable arrangement to be taken into account but also, integrate a real margin into the response time. For example, the installation of a two-hour passive fire protection protection on redundancies of power cables for backup of important elements allows the associated safety functions to be maintained at least during this time and this, without taking into account the beneficial effect of an intervention. These methods are a good practice in terms of safety and come as a variation of the regulations in force to make the demonstration more robust.

**Silo 130**

More concretely, the functionality integrated into the premises can induce a high heat load or a vulnerability to be protected. Thus, fire-resistant surveillance and compartmentalization measures are implemented in order to isolate the potential danger or sensitive equipment. This type of protection when it is passive, applied in particular to elements important for establishing and maintaining a safe state, not only allows the failure of an active or maneuverable arrangement to be taken into account but also, integrate a real margin into the response time. For example, the installation of a two-hour passive fire protection protection on redundancies of power cables for backup of important elements allows the associated safety functions to be maintained at least during this time and this, without taking into account the beneficial effect of an intervention. These methods are a good practice in terms of safety and come as a variation of the regulations in force to make the demonstration more robust.

**Osiris**

Barriers to limit the fire propagation are detailed in chapter F-I-3.3.1 and F-I-3.3.3.3 of the French national report.

**UNGG**

The design approach and the description of fire compartments and/or cells design are descried are described in “F-II-3.3.1.1 and F-II-3.3.1.2 Prevention of fire spreading” (p238).

How are ventilation systems divided among trains/ compartments?

**Tricastin**

Segregation and isolation provisions are described in “Ventilation system A-I-3.3.2.1 (p169)

**Framatome Romans**

The elements are given in paragraphs C-II-3.3.1.1 and C-II-3.3.2 of the report.

**UP3A-T2**

In addition to robust compartmentalization, there is the principle of ventilation of the premises which makes them confined and under-ventilated. In this way, the limitation of the oxygen supply occurs inexorably and the possible dissemination from the premises (concerned by the fire) would be controlled by the potential recovery of this by the ventilation of the adjacent premises. Several independent ventilation networks exist for the same building and successively surround the areas most at risk of contamination to make it possible to manage confinement on a building scale.

**MELOX**

Two separate extraction networks MD (Medium Depression) and HD (High Depression) exist depending on the confinement class of the rooms C2 (very low risk of contamination) and C3 (low risk of contamination). C1 rooms (zero contamination level) have independent blowing and extraction systems. The glove boxes (C4) are on the THD (Very High Depression) network or on the nitrogen network.

Fire dampers (standard model) are positioned on the supply and extraction networks of rooms classified as fire sector and containment class C2.

Fire dampers (reinforced model) are positioned on the supply and extraction networks of rooms classified as fire sector and containment class C3, as well as on the THD network and on the nitrogen network of glove boxes.

**Pool D - T0**

In addition to robust compartmentalization, there is the principle of ventilation of the premises which makes them confined and under-ventilated. In this way, the limitation of the oxygen supply occurs inexorably and the possible dissemination from the premises (concerned by the fire) would be controlled by the potential recovery of this by the ventilation of the adjacent premises. Several independent ventilation networks exist for the same building and successively surround the areas most at risk of contamination to make it possible to manage confinement on a building scale.

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**Osiris**

The design and installation of the ventilation system (fans, power supply, etc.) are not divided among trains/compartments since it is not required by FSA (see chapter F-I-3.3.2 of the French national report).

**UNGG**

Segregation and isolation provisions are described in “Ventilation system F-II-3.3.2.1 (p239)

What improvements could be achieved to older existing facilities? What limitations are there to do that and what are the alternative measures to cope with that?

**Tricastin**

During *RP4 900*, and at the request of ASN, notable improvements were made in the fire risks management case, in particular by performing sectorisation verification studies, based on the fire resistance characteristics of the sectorisation components and the movable fire load present in the rooms. These studies were supplemented by the verification of the effects of smoke pressure on the sectorisation components to ensure that they retain their effectiveness. In addition, the new methods used allowed the identification of sectorisation aspects for which correct working is particularly important. For example, the fire doors which must be kept closed have been identified and will be subject to specific monitoring.

Refer to A-I-3.3.1.1 for more details.

**Framatome Romans**

In addition to the actions listed in paragraphs II-2.3.4, C-II-3.1.3.3, C-II-3.2.4.3, C-II-3.3.3.3 and C-II, for older existing buildings on can mention that reinforcements relating earthquake were made for compartments.

No specific limitations are encountered.

**UP3A-T2**

For older installations, the buildings are equipped with only two ventilation systems, namely one for the areas accessible to personnel and the other for the process equipment and the cells housing it. These networks are provided with a monitored filtration system (at the level of the last filtration barrier) presenting a significant number of pleated last barrier filters, a characteristic which significantly increases the surface area and the purification capacity. The best compromise defined to improve the working environment represented by old installations is to reinforce internal compartmentalization, particularly in corridors or staircases. This type of improvement inevitably has its limits due to the nature of the dismantling projects that must be carried out or the technical and economic impact. If such generic improvements can be defined during safety reviews, provisions specific to the various dismantling sites complete the system in line with the constraints and needs identified to manage these phases.

**MELOX**

MELOX's facilities are of fairly recent design (built in the nineties).

**Pool D - T0**

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**Silo 130**

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**Osiris**

Simple arrangements such as implementation of fire doors, penetration sealing, etc. can be carried out as soon as it is feasible and affordable.

Otherwise, it is appropriate to act on other measures like:

* evacuation of fire sources and/or unnecessary fire loads,
* protection of radioactive substances vulnerables to the fire effects,
* strengthen monitoring provisions (FLS, etc.) during operations with fire risks and high radiological issues,
* implementation of specific fire extinguishing means,
* etc.

**UNGG**

Refer to F-II-3.3.1.1. page 238.

How is the management concerning fire compartmentation performed as the facility is growing?

**Tricastin**

Segregation and isolation provisions are described in “Ventilation system A-I-3.3.2.1 (p169)

**Framatome Romans**

As mentioned in paragraphs II-2.3.2 and II-2.3.5, a modification process is in place, governing the creation or modification of facilities. A reference document is the site’s fire standard, which provides the provisions to comply with.

**UP3A-T2**

When designing the most recent installations, a correlation between the heat load density and the fire compartmentation was defined on the basis of a normative reference. In particular, premises whose heat load density exceeded 600 MJ/m² were classified as “fire sectors”. The fire resistance of these premises was set with a fire rating of two hours. More generally, as a variation of this principle, functionalities of premises, synonymous with a high heat load density, were retained for such classification (electrical premises, IT premises, control room, etc.). A fire sector is thus equipped with fire walls of degree two hours and all the crossings and openings of such a room also have this same qualification. In the operational phase, this functionality approach, synonymous with high heat load density, is maintained to assess the need for fire compartmentation. However, in addition, the presence of important elements for the safety of the installation, the existence of an important axis of intervention for setting and maintaining a safe state, etc. are other elements taken into consideration in the assessment of need. Thus, passive fire insulation can be recommended as close as possible to the element, which makes it possible to take into account a possible failure of a separating fire opening.

**MELOX**

Installation modifications are subject to an authorization request (internal or external). Modifications in installations are analyzed to ensure that protection measures remain appropriate.

**Pool D - T0**

When designing the most recent installations, a correlation between the heat load density and the fire compartmentation was defined on the basis of a normative reference. In particular, premises whose heat load density exceeded 600 MJ/m² were classified as “fire sectors”. The fire resistance of these premises was set with a fire rating of two hours. More generally, as a variation of this principle, functionalities of premises, synonymous with a high heat load density, were retained for such classification (electrical premises, IT premises, control room, etc.). A fire sector is thus equipped with fire walls of degree two hours and all the crossings and openings of such a room also have this same qualification. In the operational phase, this functionality approach, synonymous with high heat load density, is maintained to assess the need for fire compartmentation. However, in addition, the presence of important elements for the safety of the installation, the existence of an important axis of intervention for setting and maintaining a safe state, etc. are other elements taken into consideration in the assessment of need. Thus, passive fire insulation can be recommended as close as possible to the element, which makes it possible to take into account a possible failure of a separating fire opening.

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**Osiris**

The BNI 40 (OSIRIS) is in decommissioning phase. In case of growing (for decommissioning purposes), new compartmentation standards are used.

**UNGG**

Segregation and isolation provisions are described in “Ventilation system F-II-3.3.2.1 (p239)

How are the fire loads linked to fire compartmentation and fire rating of barriers?

**Tricastin**

The fire duration calculation is used at the design stage for sizing the sectorisation. It is based on the fire duration determined from knowledge of the fire load density, using the standardised thermal curve (per RRC-I-97). Refer to “Design approach” A-3-3.3.1.1.

**Framatome Romans**

See answers to questions FR-E-745 2.a, b and c.

**UP3A-T2**

See previous answers

**MELOX**

In the event of a fire, the fire is under ventilated. The fire load present then has an influence on the duration of the fire but not on the power developed. The sectoring elements (120 min fire-rated for a standardized fire) generally have sufficient robustness to remain effective for the duration of real fires that can be envisaged.

**Pool D - T0**

See previous answers

**Silo 130**

See previous answers

**Osiris**

The justification of the sufficiency of the fire resistance rating of fire compartments is based on a qualitative approach taking into account the following criteria:

* fire loads (permanent and transient fire loads such as a forklift in an airlock) and type of fire scenario that could be induced (heat release rate, flashover phenomenon, etc.),
* the adequacy between fire resistance performances (duration and thermal stress) and the intervention capacities of the rescue teams.

If necessary, the qualitative justification can be supplemented by a quantitative justification (quantification of thermal stress, etc.).

**UNGG**

The fire duration calculation is used at the design stage for sizing the sectorisation. It is based on the fire duration determined from knowledge of the fire load density, using the standardised thermal curve (per RRC-I-97). Refer to “Design approach” F-II-3.3.1.1.

## Maintenance/Access/Inspection of fire dampers (not relevant for all facilities)

**RHF**

See NAR §B 3.3.1 and §B 3.3.2 for details: no fire sector in ILL (except some rooms of ILL4 building,i.e: hostaging Reactor I&C) - Therefore ventilation in reactor building is stopped.

What are types and frequencies of testing/inspection of fire dampers? How is this applied to (nearly) inaccessible dampers?

**Tricastin**

Monitoring programmes define the maintenance of:

1. Flaps and isolating fire-break components of the smoke control system;
2. Fire dampers of the ventilation systems (inspection of the actuators, inspection or replacement of intumescent seals, integrity of the damper, verification and replacement of fuses every 5 years, etc.).

The interlocked fire dampers undergo periodic manoeuvrability and closure tests following triggering of the fire detection system.

Monitoring programmes include inspection of the dampers actuators every five years.

Monitoring programmes define the maintenance of inaccessible fire dampers : check the integrity of the valve (non-degraded fire caulking) every five years.

Refer to A-I-3.3.2.2 p 170 “Performance and management requirements under fire conditions” and to A-I-3.3.3.1 “Overview of strengths and weaknesses” (p171) for further details.

**Framatome Romans**

As mentioned in paragraphs C-II-3.2.1.2 and C-II-3.3.1.3 the items of equipment involved in the control of the fire risks undergo periodic inspections and tests. Fire dampers are tested annually.

The tests consist of:

* verification of operation for fire dampers interlocked with fire detection,
* verification of operation of open and closed positions (remote information and locally, visually),
* local and remote manoeuvrability.

All fire dampers are accessible.

**MELOX**

The controls and maneuvers of the fire dampers are tested annually. Maneuverability tests cannot be carried out on the dampers of the glove boxes ventilation networks (nitrogen and THD) because they would lead to the dispersion of nuclear material in the rooms.

**Pool D - T0**

Maintenance of the fire dampers applied to the perimeter of Swimming Pool D is carried out on an annual basis:

* Periodic inspection: functional test;
* Preventive maintenance: maintenance according to manufacturers' recommendations.

All fire dampers are in accessible areas.

**Silo 130**

Maintenance of fire dampers applied to silo 130 is carried out on an annual basis:

* Periodic inspection: functional test;
* Preventive maintenance: maintenance according to manufacturers' recommendations.

All fire dampers are accessible.

**Osiris**

Fire dampers are tested annually, or every 6 months for the ones without servo-control. All fire dampers are accessible.

**UNGG**

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Monitoring programmes define the maintenance of inaccessible fire dampers: check the integrity of the valve (non-degraded fire caulking) every five years.

Refer to F-II-3.3.2.2 p 239 “Performance and management requirements under fire conditions” and to F-II-3.3.3.1 “Overview of strengths and weaknesses” (p240) for further details.

What insights have been gathered and improvements of the dampers or test/inspection have been made?

**Tricastin**

Refer to previous answer.

**Framatome Romans**

No significant insights or improvements were gathered in recent years on this topic. The installation of fire dampers takes account of the state-of-the-art.

**MELOX**

The operating experience feedback and periodic checks are very satisfactory. A study is underway to verify the feasibility of an inspection of a fire damper.

**Pool D - T0**

The new fire dampers available on the market and designed by suppliers have an electric motor which, when triggered, allows controlled and therefore cushioned closing. This new technology is now implemented in particular during action plans resulting from safety reviews.

**Silo 130**

The new fire dampers available on the market and designed by suppliers have an electric motor which, when triggered, allows controlled and therefore cushioned closing. This new technology is now implemented in particular during action plans resulting from safety reviews.

**Osiris**

An internal examination of fire dampers using colour endoscopy is recommended as part of the plant periodic nuclear safety review. This was carried out as part of the compliance review of BNI 40's nuclear ventilation. The success criteria were the following: absence of corrosion, absence of seal damage, ease of rotation of the shaft, absence of cracks, absence of deformation, absence of material likely to interfere with flap closure.

**UNGG**

Refer to previous answer.

## NPP: Ageing management of fire passive and active SSC

Describe which fire active and passive SSCs are covered by the aging management program.

Describe in general the preventive actions to minimize and control ageing degradation on fire protection.

Describe specifically how the aging management program covers/considers fire barriers, fire extinguishing system and the firewater distribution network.

Describe in general the monitoring and trending of ageing effects on FP SSC?

Which kind of deficiencies of active and passive FP SSCs in scope of aging management program were identified in last 10 years?

Describe how these deficiencies were corrected (e.g. what kind of replacement, improvement or modifications?

**Tricastin**

Fire protection equipment is covered by a preventive maintenance programme, which takes into account the effect of ageing.

For example, for fire dampers, as described in “A-I-3.3.2.2. Performance and management requirements under fire conditions» (p206), « Monitoring programmes define the maintenance of […] fire dampers of the ventilation systems (inspection of the actuators, inspection or replacement of intumescent seals, integrity of the damper, verification and replacement of fuses every 5 years, etc.).

For example, for fire extinguishing systems, as described in “A-I-3.2.2.2. Types, main characteristics and performance expectations” (p138), “A preventive maintenance programme prescribes the fire network maintenance work (piping, sprinkler system, nozzle system, fire-fighting water standpipes, etc.). To give an example, it requires the verification of the condition of the sprinklers every 2 cycles ± 1 (signs of impact, corrosion, leakage, etc.) and the replacement of the sprinkler if any damage is found.”

**Framatome Romans**

In the framework of the periodic safety review, an analysis was made to identify the SSCs to include in an ageing management program.

Were identified SSCs subject to periodic inspections and tests, regular checks during operations, periodic preventive replacements, periodic inspections of the civil engineering elements. For the remaining SSCs field inspections were undertaken.

These elements constitute the SSC’s surveillance program. As far as fire risk is concerned, the following SSCs are part of the program: civil engineering elements including fire sectors, fire-break protections, fire dampers, fire openings, sealing of penetrations, ventilation network, last filtration level.

The FDS, fire extinguishing systems and the firewater distribution network are not part of the ageing program. However, they are subject to periodic inspections and tests. In addition, the FSS is designed to self-detect malfunctions and actions are launched to address the obsolescence of the FDS (see paragraph C-II-3.2.4.1).

The preventive actions to minimize and control ageing degradation are: periodic inspections and tests, regular renewals, maintenance operations triggered by field inspections, detection of drifts, recurrent malfunctions, not anticipated failures, regular checks during operations, periodic preventive maintenance. In addition, periodic safety reviews contribute to the management of ageing.

Trending effects that can be mentioned for FP SSCs: corrosion, splits/clefts, abrasion, deformation, impacts, wear, tears…

No specific information to answer to this question.

In can be mentioned that periodic inspections of the civil engineering elements led to the detection of corrosion and cracks. These deficiencies are monitored and, if deemed necessary, corrected.

The deficiencies are corrected by usual methods depending on the instance, i.e. either improvement, repair, filling, replacement, etc.

**MELOX**

The obsolescence and aging monitoring process concerns active equipments for detection and extinguishing functions (detectors, control units, automation systems, fire dampers).

The active and passive equipments are subject to a monitoring program for proper functioning through periodic tests or good state of conservation during safety reviews.

The obsolescence and aging monitoring process concerns active equipments for detection and extinguishing functions (detectors, control units, automation systems, fire dampers).

Monitoring the aging and forecast obsolescence of equipment is a process allowing in particular to keep a stock of spare parts, to check possible repair conditions, to plan over time the replacement and development of equipment

The obsolescence of active detection and extinguishing equipment has led to replacement campaigns for numerous detectors and fire control panels.

Detectors and control units affected by obsolescence issues have been replaced by similar equipment of recent design.

## OPEX on fire events

How do you classify and report on fire related events? Are smouldering events reported?

**Tricastin**

Each fire that occurs on the sites undergoes a detailed analysis which is recorded in a Findings Sheet. In these sheets the fires are analysed from two aspects :

* The cause aspect, which enables lessons to be learned about its occurrence and to propose improvements in prevention of the risk of fires occurring.
* The treatment aspect, which serves to adjust the fire-fighting baseline requirements and propose the necessary improvements in the treatment

EDF qualifies as a "fire" and analyses any situation causing the slightest emission of smoke or the slightest rise in temperature, whether detected automatically or by a witness. Fires are analysed for LFE ( Learning From Experience purposes as from smouldering fire level, with the intention of memorising and addressing )even the slightest low-level events.

All fires, of whatever nature, are analysed and classified. This classification makes it possible to identify 4 levels of fire:

* REX: linked to incipient and very localized fires around the ignition zone.
* Minor: Representing fires that have begun to develop.
* Marking : for fully developed fires
* Major : For fires that spread outside the initial volume.

The procedures for declaring and classifying fires are the subject of an applicable reference framework

Refer to “Lessons learned from events” §A.1.3.1.3.2 (p77) for further details.

**RHF**

Yes, smouldering events are reported exactly as "real" fire departures throug abnormal events managing procedure.

**Framatome Romans**

As mentioned in paragraph C-II-3.1.2 of the report and in answer to question FR-E-745 6, any fire related event is registered and analysed though the process for the management of deviations. This process includes of course smouldering events.

**MELOX**

Any observation that appears out of the ordinary is recorded in a database. Depending on the seriousness of the problem, each observation is classified either as a simple observation, or as a deviation, or as a significant deviation.

A detailed analysis is carried out for each deviation. Significant deviations also require a declaration to the safety authority.

In the field of fire, the types of potential observations are:

* Occurrence of fire outbreak
* Fault in automatic detection and supervision systems
* Fault of a sectoring device
* Untimely triggering of servo control
* Absence of detection (this item allows smoldering fires to be reported if deterioration of an equipment due to overheating has been observed).

**Pool D - T0**

The criterion for communicating a fire to ASN is provided when an accidental combustion occurs in a controlled area. An aggravating element is retained in the case where the combustion is likely to have significant consequences or to affect the availability of equipment participating in an important function for safety.

A smouldering fire, as long as it meets the above criteria, is the subject of a report.

**Silo 130**

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A smouldering fire, as long as it meets the above criteria, is the subject of a report.

**Osiris**

Any events, even smouldering events are recorded thanks to an « event and improvement sheet », then analyzed as safety related events. The origins of the events are studied and ways of improvement are sought. Some fire related events must be declared to the regulatory body (ASN).

**UNGG**

EDF relies primarily on feedback from these nuclear facilities and on external feedback, whether French or international (see EDF common practices - A-I-3.1.3.2).

How and to what extent is information on these fire events shared and/or discussed national and international level? If applicable: what are the current fire safety related topics that are discussed on national level? Is there an exchange with conventional industry?

**Tricastin**

All fires are presented to fire actors on a monthly basis through a communication sheet. An annual REX is submitted to ASN. Events requiring more in-depth sharing are presented at the meetings of the Fire Officers Community of Practice. Information is sent to WANO Paris Center to share the most significant events.

As an example A-1-31 33“Overview of actions and implementation status”, the current fire safety related topics that are discussed on national level is management of temporarily stored fire loads : EDF is currently looking into ways of improving this topic, based on the principle of bringing the conditions of application of the temporary fire load storage rules into line with the DMRI, according to the reference state of each plant unit. The approach is based on using the available fire studies to identify the possibilities of temporary storage of fire loads in premises that do not call into question the conclusions of these studies. These temporary storage possibilities shall be interlinked with the recurrent needs identified by the licensee and implemented by sharing the best practices available and/or already applied by the sites. They shall be defined with the aim of adapting the means used to the risks (temporary storage prohibited in certain sensitive places, restriction of the quantities or nature of the fire loads stored, setting up appropriate compensatory means, etc.).

In this context, EDF is developing a methodology which aims to use the fire studies to identify temporary storage possibilities within the premises for all the plant units.

The industrial fire REX is fed by the analysis of the ARIA database (Analysis, Research and Information on Accidents) managed by the BARPI (Bureau d'Analyse des risques et pollutions industrielles) which lists incidents, accidents or near misses, including fires that have caused or could have harmed the public or the environment, by the analyses carried out by the BEA-RI (Bureau d'enquêtes et d'analyses sur les risques industriels), by exchanges between industrialists, particularly within the framework of professional associations such as France Chimie.

**RHF**

Topics discussed are generally linked to the in-depth analysis of the event as for the other safety event.

**Framatome Romans**

Part of this question calls for an answer at national level.

Every INES event is communicated to and discussed with the National Authority.

Every year a summary and analysis of all registered events is transmitted to the National Authority.

As mentioned in paragraph C-II-3.1.3.1 the site is a partner of the inter-licensee working group on the fire theme. This group shares experience on topical subjects, such as singular events. Within Framatome a fire protection community is also in place.

**MELOX**

Significant events in the nuclear or conventional industry may lead to inspections or requests for information from the safety authority on all national nuclear installations.

**Pool D - T0**

Interesting events can be shared up to the international level, particularly as part of membership in the WANO organization.

The Orano group has a network of correspondents on the subject of fire who meet regularly. On these occasions, feedback of interest is presented and external speakers may be solicited. In the same way, good practices are shared with a view to being formalized in the group's repository.

Case of the REX of an event occurring in 2008 within a workshop other than those covered by this approach: rupture of sectorization (by opening the fire door of the premises) following a release of extinguishing gas (FM 200). The resistance of a fire door differs depending on the number of leaves and the direction of opening. In this case, the situation brought together the most unfavorable conditions, namely, a double-leaf door opening towards the outside of the room protected by the extinguishing device using FM 200. The R&D carried out under the return of Experience shows that the level of overpressure inherent to a release of FM 200 in the typical premises of our installations would be of the order of 15 to 20 mbar; However, a fire door whose integrity of the attachment points is preserved cannot open under these conditions. The verification of this point of interest has been integrated into our periodic verification practices, particularly for these types of fire doors.

**Silo 130**

Interesting events can be shared up to the international level, particularly as part of membership in the WANO organization.

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**Osiris**

Fire safety managers at each CEA sites collect information related to fire starts occurring on their respective perimeters (via monitoring carried out by the on-site brigades, BNI, etc.).

Every six months, seminars are organized at the national level and each site presents the fire starts that have occurred within their perimeter. The analysis of the events may give rise to national rules.

The CEA national fire safety representatives can also, during specific meetings focusing on fire risk between French nuclear operators, share feedback from fire starts.

There is currently no framework for discussion on this topic with the conventional industry.

**UNGG**

EDF relies primarily on feedback from these nuclear facilities and on external feedback, whether French or international (see EDF common practices - A-I-3.1.3.2).

Is there an exchange with conventional industry?

**RHF**

No, indirectly with common suppliers (i.e SIEMENS, or sprinklers installers, passive protection retailors,...)

Can you provide information on events related to fire at your facilities which led to (significant) improvements of fire protection within your country (causes, improvements and relevant lessons learned)? Same question for external experiences (national, international, other industries).

**Tricastin**

The periodic safety review approach is thus based on taking account of the following lessons learned from national and international experience feedback ( “I-2.1.5.1. Overview of actions” (p31)).

In collaboration with IRSN, EDF is a participant in OECD’s FIRE operating experience feedback programme.

EDF has taken on-board the lessons learned from the earthquake-induced fire at Kashiwasaki-Kariwa in 2007. The safety analysis carried out on the power transformer fires concluded that even without the planned extinguishing resources, a fire did not lead to any safety consequences.

**RHF**

No significant fire event occurred in ILL which could have led to improvement of fire protection. At the moment, coming from working groups between other NBI, aerosol-based extinction systems are being investigated since these systems were initially developed and proved harmless and efficient for spaceborne stations.

**Framatome Romans**

No information is available on events related to fire at our facilities which led to (significant) improvements of fire protection within our country.

Following the fire which occurred on September 26th, 2019 at the Lubrizol facility in Rouen, France, requests were sent by the National Authority. They concerned:

* the robustness of our defence in depth, notably the provisions for fire prevention and our fire-fighting operational organisation, means and training;
* the management of hazardous chemicals and the assessment of the associated risks.

An improvement action was identified. It concerned the lack of a precise inventory of the chemicals with, for everyone, its nature, location, quantity, etc. This action has been undertaken.

**MELOX**

Experiences, internal or external, have not led to significant improvements at the national level.

**Pool D - T0**

To date, there is no feedback from national, international and other sectors requiring consideration in the selected installations and vice versa.

**Silo 130**

To date, there is no feedback from national, international and other sectors requiring consideration in the selected installations and vice versa.

**Osiris**

No fire that occured in CEA facilities has led to significant improvements in fire protection in France.

Concerning international feedback, the fire followed by an explosion which occured on March 11, 1997 at Tokai Mura highlighted the fire risk in relation with the exothermic reaction between salts and bitumen. This event led to an instruction from the French Nuclear Safety Authority in order to verify that the BNI (e.g. BNI 35) concerned by this risk have appropriate prevention and protection means (e.g. temperature monitoring).

For other industries, the fire that occured at Lubrizol SEVESO site in Rouen (September 26, 2019) led to a lot of French regulatory improvements concerning installations classified regarding the environmental protection (e.g. decree of May 26, 2014 amended).

In the FSA field, feedback (national and international) is taken into account.

**UNGG**

EDF relies primarily on feedback from these nuclear facilities and on external feedback, whether French or international (see EDF common practices - A-I-3.1.3.2).

## Decommissioning: fire safety strategy, with indications of development for decommissioning activities

Describe which elements of the fire safety strategy (in the areas of prevention, passive safety and ventilation as covered by the NAR) have/had to be further developed or modified for the decommissioning phase and how?

**Osiris**

The transition from the operating to the decommissioning phase required a complete overhaul of the existing FSA and instructions, due to the change in activities (from a reactor in operation to decommissioning activities) and the reduction in staff numbers (security duty watch system was introduced after stopping the shift teams). It implied, by example, to adapt the strategy of nuclear ventilation management in fire situation to the risk and to the workforce.

**UNGG**

When the facility is decommissioned, the fire analyses are repeated to size the countermeasures in line with the new safety challenges. These analyses are regularly updated to take account of changes in the facility as a result of the progress of the dismantling works. In the dismantling scenarios, the support functions are part of the elements that are dismantled at the end when the fire risk and/or the source of risk are residual.

# Active fire prevention

## fire detection

Please clarify what is the robustness against earthquake of the fire detection system and alarming system.

**Tricastin**

For its participation in safety sectorisation, the fire detection system instrumentation and control (I&C) meets the requirements of the fire directives in effect. As such, it remains functional after an earthquake of OBE[[1]](#footnote-1) intensity. It is also designed, from the robustness aspect, not to send untimely commands to other elementary PIC systems during an earthquake of DBE[[2]](#footnote-2) intensity. (Example: untimely closure of fire dampers when earthquake resistant ventilation is required). Refer to §A-I-3.1.2 for further details.

**RHF**

Only detectors for Safeguards systems (post-Fukushima) are earthquake proofed.

How does the fire detection system allow to locate precisely the location of fires? Is the fire detection system addressable or not?

**Tricastin**

Different types of fire detectors are installed in the site buildings. The fire detectors are addressable (identifiable), they are distributed in the rooms to monitor and grouped in detection zones covering geographically defined areas. The fire detection zones are consistent with the fire volumes. The fire detection line is designed such that a fire in one fire volume does not cause loss of detection in the other fire volumes concerned.

Refer §A-I-3.2.1.2 “Types, main characteristics and performance expectations”

**RHF**

Yes, all detectors are addressable.

**UP3A-T2**

Expressing the need for a fire detection system for a premises depends on objective criteria such as the functionality of the premises (synonymous with high heat load density), the presence and vulnerability (to thermal effects for example) of an important element to ensure a safety function, the importance of the areas of intervention.

No automatic fire detector is installed in a room which has little or no heat load and electrical equipment. For example certain corridors, staircases or technical rooms in which the equipment present is essentially non-combustible.

**Pool D - T0**

Expressing the need for a fire detection system for a premises depends on objective criteria such as the functionality of the premises (synonymous with high heat load density), the presence and vulnerability (to thermal effects for example) of an important element to ensure a safety function, the importance of the areas of intervention.

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**Silo 130**

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No automatic fire detector is installed in a room which has little or no heat load and electrical equipment. For example, certain corridors, staircases or technical rooms in which the equipment present is essentially non-combustible.

**Osiris**

The fire detection system is addressable (see § FI-3.2.1.1 of the French national report).

**UNGG**

Different types of fire detectors are installed in the site buildings. The fire detectors are addressable (identifiable), they are distributed in the rooms to monitor and grouped in detection zones covering geographically defined areas. The fire detection zones are consistent with the fire volumes. The fire detection line is designed such that a fire in one fire volume does not cause loss of detection in the other fire volumes concerned.

Refer §F-II-3.2.1.2 “Types, main characteristics and performance expectations”.

Please describe the strategy and criteria for selecting rooms where to install fire detectors in rooms. In which types of rooms are no fire detectors installed?

**Tricastin**

The premises are permanently monitored by a general fire detection network which ensures:

* Rapid detection of an incipient fire;
* Activation of the fire alarm;
* Locating of the fire outbreak;
* Memorisation of the first fire;
* Control of the isolation components slaved to the fire detection:
	+ Closure of certain fire dampers,
	+ Starting of certain fire protection systems installed at fixed stations (spraying of the diesel generator sets for example),
	+ Closure of certain fire doors that were kept open for ventilation purposes.
* Monitoring of progression of the fire.

**RHF**

All rooms in radiological areas are fitted with detectors (but lavatories)- In addition, when a room comprises a PIC redundoncy of detectors are ensured.

**UP3A-T2**

The fire detection system is subject to normative rules for installing detectors which are the best recognized techniques in the field. Thus, depending on the configuration of the premises, this or that detection technology is retained. In accordance with this normative framework, proper functioning tests are carried out to validate acceptance of the installation.

Addressable detector technology is used to make detection localization more reliable.

**Pool D - T0**

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Addressable detector technology is used to make detection localization more reliable.

**Silo 130**

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Addressable detector technology is used to make detection localization more reliable.

**Osiris**

The CEA has a method based on a multi-criteria approach (fire sources, nature and quantity of fire loads, dangerous substances, SSC) to justify, without additional analysis, the absence of implementation of automatic fire detection (AFD) in a room. In all other cases (not meeting the criteria of the CEA method), the implement an AFD is the result of a specific analysis.

For example, the absence of implementation of AFD in toilets is justifiable by the application of the method. Inversely and due to the potential fire load, this method cannot justify the non-implementation of AFD in an office room. In this case, it requires being able to justify that potential issues in case of fire spread in the office room has no impact on the nuclear fire safety demonstration and that the presence of AFD in circulation which serves the office room is sufficient.

**UNGG**

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* Activation of the fire alarm;
* Locating of the fire outbreak;
* Memorisation of the first fire;
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	+ Closure of certain fire dampers,
	+ Starting of certain fire protection systems installed at fixed stations (spraying of the diesel generator sets for example),
	+ Closure of certain fire doors that were kept open for ventilation purposes.

Monitoring of progression of the fire.

What is the ability of the fire detection system to function in case of loss of power? What is their emergency power supply arrangements, criteria and autonomy (how long can they work without power?)?

**Tricastin**

The detectors in the buildings containing PICs have a battery-backed standalone power supply in accordance with the regulations in effect.

**RHF**

Batteries - 12h autonomy

**UP3A-T2**

In case of failure:

* one or more detectors: isolation by deprogramming the faulty detector(s) is carried out and the repair must be carried out within a predefined time frame; in the meantime, compensatory measures must be agreed;
* the fire control panel: emergency power supply via battery allows the function to be maintained for 12 hours. In the event of a technical breakdown leading to a total loss of monitoring, the repair must be carried out within a predefined time frame; in the meantime, compensatory measures must be agreed and in particular bans on hot spot work or other operating constraints depending on the case.

**Pool D - T0**

In case of failure:

* one or more detectors: isolation by deprogramming the faulty detector(s) is carried out and the repair must be carried out within a predefined time frame; in the meantime, compensatory measures must be agreed;
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**Silo 130**

In case of failure:

* one or more detectors: isolation by deprogramming the faulty detector(s) is carried out and the repair must be carried out within a predefined time frame; in the meantime, compensatory measures must be agreed;
* the fire control panel: emergency power supply via battery allows the function to be maintained for 12 hours. In the event of a technical breakdown leading to a total loss of monitoring, the repair must be carried out within a predefined time frame; in the meantime, compensatory measures must be agreed and in particular bans on hot spot work or other operating constraints depending on the case.

**Osiris**

As required by the French standards (NF S 61-970) for fire detection system, in the event of a power outage, specific set of batteries ensure an autonomy of 12 hours in stanby mode (operational monitoring) followed by an autonomy of 10 minutes in fire alarm conditions.

**UNGG**

The detectors in the buildings containing PICs have a battery-backed standalone power supply in accordance with the regulations in effect.

Please provide detail of the safety class of the fire detection systems.

**Tricastin**

The fire detection system is safety classified (IPS-NC – Safety-Important – Not Classified) in all the buildings containing Safety Important Components (SICs): nuclear island buildings, the pumphouse, SEC (essential service water system), Galleries and the Ultimate Backup Diesel Generator Set Building.

## Fire suppression

Please clarify what is the robustness against earthquake of the fire suppression systems.

**Tricastin**

On account of the technical requirement associated with the lessons learned from Fukushima, EDF has assessed the Safe Shutdown Earthquake (SSE) resistance of the structures and equipment items that are subject to a requirement for resistance to the Operating Basis Earthquake (OBE) and contribute to the extinguishing of a fire (fixed extinguishing systems). On completion of these studies, the fixed extinguishing systems of:

* The conventional island and the nuclear island (inside the reactor building) are robust to the SSE without any modifications;
* The nuclear island (outside the reactor building) is reinforced in lot B to the SSE by deploying modifications in the robustness of the fire extinguishing network outside the reactor building

The fire protection equipment required by the safety case complies with the Operating Basis Earthquake (OBE)[[3]](#footnote-3) requirements in terms of seismic resistance and is confirmed for the Safe Shutdown Earthquake (SSE)[[4]](#footnote-4).

The fire protection equipments are checked to ensure that should it fail in the event of an earthquake it does not represent a hazard for safety-classified equipment or is not itself damaged by the possible failure of any non-seismic classified equipment.

**RHF**

Only the future Sprinkler system in Level C (= experimental level) of reactor building has been designed earthkake proof (to SMS level)

Please provide detail of the safety class of the fire suppression systems.

**Tricastin**

Fixed extinguishing means are planned for in relation to the safety case (in this case they are usually automatic) or protection of the equipment.

Fixed extinguishing systems are installed in certain rooms when necessary, on account of safety sectorisation:

* In the rooms with fire duration exceeding 1 hour and 30 minutes forming part of a safety fire volume;
* When they are necessary for the justification of certain safety fire zones;
* When they are necessary for addressing common modes.

Some extinguishing systems are safety classified IPS-NC : in the in Nuclear island building, electrical buildings nuclear island buildings, ant the means of production and the fire-fighting water production system pressurises and supplies the water to the general fire-fighting distribution systems (fixed extinguishing systems and fire-fighting means).

Any non-required and non-isolable section connected to a fixed extinguishing system required under of the security sectorization is classified as EIPS by continuity.

The systems supplying water for the fire-fighting means are protected against freezing.

The fixed extinguishing systems installed on account of the safety case in the fuel buildings (BK), the operations building (BW) and the electrical building (BL) do not have active equipment. Only the nuclear auxiliary buildings (BAN), the reactor building (BR) and the diesel generator set buildings have fixed sprinkler systems - whose pipes are maintained in air under normal operating conditions - comprising active equipment. The failure of these equipment items is postulated.

The local accessibility and operability of these items (valves) have been verified. The existence of functional redundancies combined with manual activation of the extinguishing systems (applying the defined operator delays) guarantees the availability of the functions to protect against the effects of the fire if fire breaks out in the rooms concerned.

Thus, the sensitivity studies conducted to assess the impact of the consequences of the fire, considering an aggravating factor applied to the active equipment of the fixed automatic fire extinguishing system, conclude that the existing provisions are sufficiently robust.

The fire protection equipments are checked to ensure that should it fail in the event of an earthquake it does not represent a hazard for safety-classified equipment or is not itself damaged by the possible failure of any non-seismic classified equipment

**RHF**

PIC's ranked 3

Please clarify what can be adverse effects of fire water? Has this been assessed? What could be the adverse consequences of fire water system actuation or break?

**Tricastin**

When the fire-fighting means are planned to fight a fire within the fire volumes (fixed means or fire hose cabinet), their design must take into consideration the common mode risks due to water. Thus:

* A sill (or change in level) is provided at the walls or boundaries separating trains A and B, unless specific studies showed that these sills were unnecessary;
* Floor drains, when present, are suitably dimensioned for the spray delivery rate and the drainage possibilities.

Penetrations in walls or boundaries separating different fire volumes are made watertight if their location makes their immersion possible.

The extinguishing agents are collected and treated to ensure the containment of radioactive materials.

EDF has undertaken the renovation of the means of retention of fire-extinguishing effluents. In this context, the preferred strategy is containment at source inside the facilities, particularly when radioactive substances are involved.

If this is technically impossible, external retention means are provided. They shall be sufficiently dimensioned to retain the fire-extinguishing effluents and the other effluents such as rainwater. The extinguishing effluent volumes and the associated retention structures are dimensioned using the CALVIN method which is based on methods used in other sectors of activity or rules taken from the regulatory texts.

Refer to “Management of harmful effects and consequential hazards” A-I-3.2.3 to further more details.

**RHF**

No adverse effect - Taken into account through safety analysis (internal flooding)

**UP3A-T2**

The harmful effects of water can be of various kinds:

* a contraindication for use with regard to a nuclear risk: risk of criticality or significant dissemination of pollution;
* flooding and destruction of equipment;
* a risk of electrification depending on the level of electrical voltage;
* vaporization of water, ...

In the controlled zones (green, yellow, orange and red), there are no fixed water extinguishing installations in charge.

The supply of water for extinguishing is carried out by human action by establishing pipes allowing the nozzle to be connected to the intervention van or even to the establishment's dedicated fire water network via dry columns. . This network is constantly maintained under pressure.

Generally speaking, there can therefore be no rupture of pipes under load, internal to a building and useful for extinguishing action. The fire water network is buried and is meshed in such a way that the unavailability of a branch, for example due to a leak, has no impact on the function to be provided.

In the event of recourse to an internal water reserve, which is a very specific case (outside the T2 workshop), it is arranged in such a way that the flow resulting from its loss of integrity is without impact.

Concerning a possible untimely triggering, such a situation is avoided to the extent that this type of extinguishing installation requires manual implementation action and a process of removing doubts prior to intervention.

**Pool D - T0**

The harmful effects of water can be of various kinds:

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**Silo 130**

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Concerning a possible untimely triggering, such a situation is avoided to the extent that this type of extinguishing installation requires manual implementation action and a process of removing doubts prior to intervention.

**Osiris**

The adverse effects of extinguishing water are mainly:

* the risk of release of dangerous substances to the environment by liquid way,
* the gravity flow towards areas not impacted by the direct fire effects which could affect the functionality of necessary systems (e.g. electrical short circuit),
* the modification of the conditions which enable to manage the criticality risk (e.g. grouping fissile substances in the same water retention).

All these points were analysed within the framework of the FSA. The use of water is possible in all the BNI 40 (OSIRIS) perimeter thanks to the nature and quantities of fissile substances. The justification for the sufficiency of sizing of fire water retention means has been provided.

Extinguishing water is only used in the perimeter of the BNI by the on-site fire brigade. There is no extinguishing system previously charged with extinguishing water in the BNI 40 (OSIRIS) perimeter.

**UNGG**

When the fire-fighting means are planned to fight a fire within the fire volumes (fixed means or fire hose cabinet), their design must take into consideration the common mode risks due to water. Thus:

* A sill (or change in level) is provided at the walls or boundaries separating trains A and B, unless specific studies showed that these sills were unnecessary;
* Floor drains, when present, are suitably dimensioned for the spray delivery rate and the drainage possibilities.

Penetrations in walls or boundaries separating different fire volumes are made watertight if their location makes their immersion possible.

The extinguishing agents are collected and treated to ensure the containment of radioactive materials.

EDF has undertaken the renovation of the means of retention of fire-extinguishing effluents. In this context, the preferred strategy is containment at source inside the facilities, particularly when radioactive substances are involved.

If this is technically impossible, external retention means are provided. They shall be sufficiently dimensioned to retain the fire-extinguishing effluents and the other effluents such as rainwater. The extinguishing effluent volumes and the associated retention structures are dimensioned using the CALVIN method which is based on methods used in other sectors of activity or rules taken from the regulatory texts.

Refer to “Management of harmful effects and consequential hazards” F-II-3.2.3 to further more details.

Please clarify the emergency power supply arrangements for fire suppression.

**Tricastin**

A series of provisions are made for extinguishing fires, depending on the case.

As an initial response, any worker located near a fire outbreak can use the appropriate hand-held fire-fighting means (water, powder or carbon dioxide extinguishers, etc.) provided in the facility to put it out.

When a fire is detected, the first recon team and the response team are sent to the place to check it is not a false alarm and to initiate the emergency actions indicated on the reflex sheet of the room concerned (acknowledgement of the fire with extinguishing attempt, emergency cut-off, checking correct operation of the automatically triggered components, check of sectorisation, etc.). If the alarm is confirmed, the external emergency services are called. They can use the following complementary means:

* Mobile fire-fighting means (fire-fighter turnout bags, fire-fighting trailers or trucks for on-site intervention, etc.);
* Water hose connected to a firefighting network (fire hose cabinet). To this end, all the levels of the nuclear island buildings are equipped with a sufficient number of fire hose cabinets connected to the fire-fighting water system. The fire hose cabinets are positioned such that the fire hose can reach any equipment item in a room, even if this room is equipped with fixed fire-extinguishing devices such as sprinklers;
* Water hose connected to a fire hydrant.

The road network within the sites, the access points and the access openings are designed to enable the rescue and fire-fighting appliances of the external emergency services, including aerial ladder trucks, to get as close as possible to the buildings. Specific means are also available to the external emergency services (dry risers, fire-fighting water standpipes, etc., distributed across the site).

In addition, fixed extinguishing means are planned for in relation to the safety case (in this case they are usually automatic) or protection of the equipment. Refer to A-I-3.2.2.1 (p112).

**RHF**

Batteries - 12h autonomy

**UP3A-T2**

The only fire-fighting equipment inside a building is the water supply columns.

These are dry columns, filled with water only during the intervention and installed in a stairwell, therefore, with no real consequences in the event of rupture. In such a case nevertheless postulated, the flow remains localized to the stairwell.

**Pool D - T0**

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**Osiris**

In the BNI 40 (OSIRIS) perimeter, there is no fixed fire extinguishing systems requiring the supply of external energy.

Concerning the extinguising water requirements estimaded by the FSA, 3 standardised hydrants are located less than 50 metres from the BNI 40 (OSIRIS) and three other at less than 100 metres. They are connected to a meshed network. There are two meshed networks on the Saclay site which can simultaneously delivery the minimum required flow rate determined by the FSA and at the required minimum pressure thanks to gravimetric means (water towel). If necessary, it is possible to pump water with fire brigade means in natural or artificial water reserves located on the CEA site of Saclay.

**UNGG**

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The road network within the sites, the access points and the access openings are designed to enable the rescue and fire-fighting appliances of the external emergency services, including aerial ladder trucks, to get as close as possible to the buildings. Specific means are also available to the external emergency services (dry risers, fire-fighting water standpipes, etc., distributed across the site).

In addition, fixed extinguishing means are planned for in relation to the safety case (in this case they are usually automatic) or protection of the equipment. Refer to F-II-3.2.2.1 (p199).

Please clarify the balance between fixed fire extinguishing and manual firefighting. What strategy has been applied? What are the main principles? Clarify how accessibility considerations during manual firefighting has been considered in this strategy.

**RHF**

See § Mainly manual firefighting. Fixed fire extinguishing in some specific rooms only where availability is targeted (i.e: reactor I§C room in ILL4 building) The future sprinkler system in level C reactor building is mainly focussed on protecting structural parts of building and preventing the extension by controlling its development, manual firefighting remains the main option to eradicate fire in totality. As far as reactor building accessibility is concerned, in the worst case, that is a situation of generalized fire within the reactor building, the stop off of the ventilation would lead to a fire self-extinction by lack of oxygen after 80 minutes. This last worst-case scenario will become highly improbable when the sprinklers system is operational in 2025.

**UP3A-T2**

Concerning all types of fixed extinguishing installations fitted to premises (fixed gas extinguishing installations), the majority are manually triggered in order to reduce the risk of accidental triggering. The premises concerned are premises classified as "fire sectors", a provision which allows any combustion to be contained for the time necessary to resolve the doubt. This type of installation has the same role as a portable means of extinguishing, that is to say that such a device allows a first intervention and stabilizes the situation while waiting for the arrival of the second aid team, equipped with professional extinguishing means. Certain criteria are established for automatic triggering of a fixed extinguishing system, namely the presence of a safety function in a room where the manual triggering time is considered long. In the same way, automatic triggering of the extinguishing system was retained for the specific case of extinguishing a fire which would occur in cells containing solvent loaded with plutonium (type of situation where the intervention conditions are complex and outside workshop T2). Thus, in all cases where combustion has been detected (technically or visually) and even in the event of suspicion, the second intervention team is mobilized in order to carry out, at a minimum, the actions of recognition and removal of doubt, otherwise extinction.

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Concerning all types of fixed extinguishing installations fitted to premises (fixed gas extinguishing installations), the majority are manually triggered in order to reduce the risk of accidental triggering. The premises concerned are premises classified as "fire sectors", a provision which allows any combustion to be contained for the time necessary to resolve the doubt. This type of installation has the same role as a portable means of extinguishing, that is to say that such a device allows a first intervention and stabilizes the situation while waiting for the arrival of the second aid team, equipped with professional extinguishing means. Certain criteria are established for automatic triggering of a fixed extinguishing system, namely the presence of a safety function in a room where the manual triggering time is considered long. In the same way, automatic triggering of the extinguishing system was retained for the specific case of extinguishing a fire which would occur in cells containing solvent loaded with plutonium (type of situation where the intervention conditions are complex and outside workshop Pool D). Thus, in all cases where combustion has been detected (technically or visually) and even in the event of suspicion, the second intervention team is mobilized in order to carry out, at a minimum, the actions of recognition and removal of doubt, otherwise extinction.

**Silo 130**

Concerning all types of fixed extinguishing installations fitted to premises (fixed gas extinguishing installations), the majority are manually triggered in order to reduce the risk of accidental triggering. The premises concerned are premises classified as "fire sectors", a provision which allows any combustion to be contained for the time necessary to resolve the doubt. This type of installation has the same role as a portable means of extinguishing, that is to say that such a device allows a first intervention and stabilizes the situation while waiting for the arrival of the second aid team, equipped with professional extinguishing means. Certain criteria are established for automatic triggering of a fixed extinguishing system, namely the presence of a safety function in a room where the manual triggering time is considered long. In the same way, automatic triggering of the extinguishing system was retained for the specific case of extinguishing a fire which would occur in cells containing solvent loaded with plutonium (type of situation where the intervention conditions are complex and outside workshop Silo 130). Thus, in all cases where combustion has been detected (technically or visually) and even in the event of suspicion, the second intervention team is mobilized in order to carry out, at a minimum, the actions of recognition and removal of doubt, otherwise extinction.

**Osiris**

The strategy deployed for BNI 40 (OSIRIS) consists of implementing provisions facilitating the deployment of extinguishing means while maintaining radioactive substances containment (dry columns, etc.).

The only fixed fire extinguising system is a system allowing the injection of a powder extinguishing agent into the hots cells by manual triggering located outside the hot cells.

Areas that are difficult to access for on-site brigade (radiological zoning, complex accessibility, etc.) require specific analyzes to be carried out within the framework of the FSA and, if necessary, compensatory provisions are defined (e.g. increasing of security lighting).

## Administrative and organisational fire protection issues

How far is the external fire brigade located? What is the intervention time needed in case of a fire inside the reactor hall outside normal working hours? How much time is needed, from the moment of fire detection, until actual firefighting starts in the field (i.e. considering need for presence of RP escort, security/access formalities, personal protection equipment for entering radiological controlled zone, etc.).

**Tricastin**

EDF and the public authorities have defined that the external fire protection of nuclear power plants will be based on the complementarity of resources. Thus, the chosen organization is based on the complementarity between: An internal organization involving stakeholders who are permanently present in the facilities The resources guaranteed by the Departmental Fire and Rescue Services, which are administrative entities of departmental authority.

In this sense, each department defines its operational coverage according to its own criteria and which are validated by the prefect. The distance between the sites and the nearest rescue therefore meets the requirements defined by the department in a public document called the Departmental Risk Analysis and Coverage Scheme (SDACR)

Intervention time in the reactor building is not dependent on working hours. It depends on the slice state in which the installation is located.

Thus, the response times for unit shutdowns in the 'Fully Discharged Reactor' configuration are similar to the deadlines used for the rest of the installation. For other configurations, these timeframes depend on the risks associated with entry into the building, where an organization is in place to define the contextual conditions for safe/secure access. Generally speaking, our in-house team must be ready to respond to all areas of responsibility within 25 minutes.

The fire-fighting organisation is described in a reference document "organisation of fire-fighting and assistance to persons". Its main instructions are taken up below:

Detection: Any person who notices an incipient or developing fire is obliged to give the alert by calling the internal number 18, and to use the extinguishing means at their disposal (fire extinguishers, etc.), as long as their own safety is not jeopardised. The call is directed to the main control room for the industrial premises or to the site's main protection station for the administrative buildings or outdoor areas.

Reception and acknowledgement of alert: Any call reporting a fire or any fire alarm is immediately and seamlessly acknowledged.

Identification and verification: Following a fire alarm or call reporting a fire, two verification officers (first recon team) are immediately sent to the location. In the case of an alarm, they check that it is not a false alarm, and they call 18 to report their findings. If there is a fire or emission of smoke, they check the completeness of the fire sectorisation within 20 minutes at the most after the alarm or fire/smoke reporting call. The first recon team is not meant to fight a developing fire, but they can fight an incipient fire with extinguishing means if it does not jeopardise their own safety.

Mobilising the emergency services:

In the case of a fire/smoke reporting call or after confirmation that the alarm is not a false alarm due to untimely alarm triggering, the operator who took the 18 call mobilises the internal response team which is available 24h/24. He also alerts the external emergency services.

Fire-fighting actions:

The response team shall be ready for action in front of the door of the stricken room 25 minutes at the most after the alarm or reporting call.  The team comprises a Response team leader and 4 team members, one of whom can assume the role of first-aid coordinator if there are any injured persons.

The response team deploys the internal fire-fighting means to limit the impact of the fire, provides assistance to persons and prepares for the arrival of the external emergency services. The priority of the NPP response teams is to assist persons and fight the fire. They are always supplemented by the operational means of the SDIS in the event of a confirmed fire.

As soon as the fire is confirmed, the emergency organisation is activated.

Intervention of the external emergency services:

Within the framework of the emergency organisation, an Emergency Operations Director interfaces with site Senior Management, the external Emergency Operations Commander (COS), the Response team leader and the control room personnel.  The Emergency Operations Director coordinates the all the mobilised players on the ground.

The public fire and emergency services take action with the teams in place in a complementary and concerted manner.

 All the personnel concerned by the fire response receive initial training which is regularly refreshed. These training courses are supplemented by exercises and periodic training sessions covered by formalised reports and debriefings.

**UP3A-T2**

In line with the details provided previously, the main emergency center closest to the establishment is that located in Cherbourg-en-Cotentin, approximately 30 kilometers away. Its total workforce is 140 firefighters and the estimated travel time without any problems inherent to road traffic, works, etc. is around 30 minutes. However, a fire station with a total staff of around 40 firefighters is also located in the town of Beaumont-Hague, less than 5 km away.

Before entering the Orano La Hague site accompanied by an escort from security teams, any worker from the external emergency center must undergo an identity check and receive their personal intervention dosimetry.

The travel time on the site depends on the installation in question. However, the site is clearly served by several traffic routes and given the dimensions of the Orano La Hague site of approximately 3km by 1 km, the travel time to reach any part of the site should not reasonably exceed 10 minutes. Once arrived at the installation in question, external emergency services can intervene under the command of the Orano intervention and radiation protection teams.

**Pool D - T0**

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**Osiris**

The off-site fire brigades are located in the surrounding cities (e.g. Ulis, Gif-sur Yvette, Massy and Palaiseau). Furthermore, reinforcement to the departmental fire and rescue service of the neighboring department bordering the CEA site is possible. Outside of normal working hours, the on-site CEA fire brigade will first carry out the fire-fighting mission. On-site CEA fire brigade must be present at the reactor building in less than 10 minutes and must establish a mean of extinguishing with water in less than 20 minutes. In accordance with the Emergency Means Commitment Plan and in the event of a fire in a BNI, the departmental off-site public fire brigade is immediately called. Even if there is no rules on this topic and depending on the ressources available and conditions of access to the CEA site, the average response time is 30 minutes for traditional means for arrival on site.

**UNGG**

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The public fire and emergency services take action with the teams in place in a complementary and concerted manner.

 All the personnel concerned by the fire response receive initial training which is regularly refreshed. These training courses are supplemented by exercises and periodic training sessions covered by formalised reports and debriefings.

What is the minimum staffing of the nearest off-site fire brigade? Can they respond to simultaneous fires inside and outside the NPP? Are there maximum or average times for arrival to the fire location for this brigade?

**Tricastin**

The principle of complementarity discussed above imposes the obligation of strong anticipation. Thus, the external fire brigade is systematically called to all witness calls and to all "justified" alarms (i.e. those that have been the subject of a doubt by an operating agent). The Fire Brigade is organised independently on the basis of the Departmental Risk Analysis and Coverage Plan of the reference department. Thus, the personnel selected to enable the defence of a sector including a CNPE are specific to the department and must guarantee the objectives set by the complementarity necessary for the defence of the site.

**RHF**

ILL is contractually linked with CEA fire brigade (located 1 km away). The contract garantees a minimum of 6 membres team to come on ILL premises in case of fire breakout. In anycase, Grenoble Firemen brigades are also systematically called; they are located closely enough to ensure a quick response time (25 min. on premises).

**UP3A-T2**

The establishment is not an electricity production center and is therefore without a nuclear reactor.

**Pool D - T0**

The establishment is not an electricity production center and is therefore without a nuclear reactor.

**Silo 130**

The establishment is not an electricity production center and is therefore without a nuclear reactor.

**Osiris**

There is no minimum staff number defined for the nearest off-site fire brigade. Human and material resources are defined by contribution to a public plan called “Departmental Risk Analysis and Coverage Scheme”. In the event of a proven fire in a BNI, the first minimum intervention forces will consist of five machines (including fire extinguishing vehicules) with 19 people. Rescue will come from any surrounding centers according to their availability.

Off-site fire brigades can respond to simultaneous fires. Response times are linked to the availability of ressources.

There is no maximum response time guaranteed concerning the off-site fire brigades response time but the feedback shows an average response time of 30 minutes for traditional means for arrival on site.

**UNGG**

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What criteria are applied for calling or not the off-site fire brigade? Is this done every time a fire is detected?

**Tricastin**

Refer to previous answer

**RHF**

When LIRT (Local Initial Response Team) has confirmed a real fire departure, external brigades are systematically called, even in the case first firefighting has been successful.

**UP3A-T2**

Given its organization and its location on the Orano site in La Hague, the establishment's intervention teams are able to intervene as quickly as possible, 24 hours a day. An order of magnitude of time following the alert with a view to an intervention carried out by the second intervention team internal to the site is indicated in the Internal Emergency Plan (PUI) of the establishment, namely of the order 25 minutes.

For the record, the Orano establishment in La Hague is autonomous in terms of human and technical resources for the defined increased scenarios. However, for defence in depth, degrees of intensity of a fire have been predefined. In application of this gradation illustrated with objective criteria, a call for external emergency services can be made to anticipate possible reinforcement. The criterion for calling external emergency services is “Extensive fire in the volume likely to spread”.

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**Silo 130**

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**Osiris**

On CEA Saclay nuclear site, public off-site fire brigade is alerted in the event of proven fire in BNI.

**UNGG**

Refer to previous answer

In case the off-site fire brigade(s) are called, what are the respective responsibilities among all actors? Who takes the lead? How is coordination ensured?

**UP3A-T2**

See previous answer

**Pool D - T0**

See previous answer

**Silo 130**

See previous answer

**Osiris**

The CEA is in command until the arrival of the off-site brigades.

The CEA becomes technical advisor upon the arrival of off-site brigades.

Coordination is ensured by cooperation between CEA site director and local authorities.

How much time is needed between a fire alarm and presence of the onsite first intervention team at the location? Same question for the onsite second intervention team (if any) or the onsite fire brigade (if any). What are the actual times measured during recent unannounced drills and exercises? Is there any regulatory requirement for this?

**Tricastin**

Following a fire alarm or call reporting a fire, two verification officers (first recon team) are immediately sent to the location. In the case of an alarm, they check that it is not a false alarm, and they call 18 to report their findings. If there is a fire or emission of smoke, they check the completeness of the fire sectorisation within **20 minutes** at the most after the alarm or fire/smoke reporting call. The first recon team is not meant to fight a developing fire, but they can fight an incipient fire with extinguishing means if it does not jeopardise their own safety.

The response team shall be ready for action in front of the door of the stricken room **25 minutes** at the most after the alarm or reporting call.  The team comprises a Response team leader and 4 team members, one of whom can assume the role of first-aid coordinator if there are any injured persons.

The response team deploys the internal fire-fighting means to limit the impact of the fire, provides assistance to persons and prepares for the arrival of the external emergency services. The priority of the NPP response teams is to assist persons and fight the fire. They are always supplemented by the operational means of the SDIS in the event of a confirmed fire.

As soon as the fire is confirmed, the emergency organisation is activated.

The regulatory requirement set out in Fire Decision 2014-DC-0417-1 sets out the obligation for fire responders to be trained and planned on an annual basis and adapted to their mission. (Articles 3.2.2-3 and 3.2.2-4). The measurement of the times achieved during these exercises makes it possible to ensure compliance with the time limits recalled in the previous points. Each site carries out an assessment of these exercises and trainings, including unannounced exercises, in order to define its adapted improvement and training program.

 All the personnel concerned by the fire response receive initial training which is regularly refreshed. These training courses are supplemented by exercises and periodic training sessions covered by formalised reports and debriefings.

As part of operational forecasting, the major possible fires led to the identification of 20 design-critical scenarios, which were examined jointly by all the SDIS's concerned. They cover all the major risks to which NPPs are exposed.

For each risk, the operational means necessary for fighting it have been defined. This generally concerns developed fires that are assumed to spread, necessitating the engagement of one or more levels of means (hydraulic means, fire engines, foam trailers, etc.).

These scenarios are regularly tested when preparing joint EDF/SDIS exercises.

For common events, the basis of organisation by phase remains identical, the licensee's means are always fully deployed, and the minimum first projection means to be deployed by the SDIS's are defined under their responsibility.

**RHF**

The first intervention is ensured within minutes by ILL staff to validate or invalidate the fire breakout and use on place extinguishers. In case of confirmed fire event, external brigade from CEA and Grenoble Firemen can take over in short times (< 10min and 25 min. respectively).

**UP3A-T2**

Concerning the first intervention team, in the same way, the time to carry out the first actions depends on the area in question. In any case, the time to reach this incriminated premises is reasonably less than that for the arrival of the second intervention team. These times are part of the criteria noted when carrying out the exercises and the times stated previously are average values. There is no regulatory intervention time and the demonstrations aim to define a set of measures for:

* either try to contain combustion and its effects for a sufficiently long time using compartmentalization only (for example by using a fire sector classification of a room of degree two hours);
* or by combining the compartmentalization with a fixed extinguishing installation to stabilize the situation while awaiting the arrival of the second intervention team.

In any case, containment control is verified by the application of the principles relating to the management of building ventilation in the event of fire, making it possible to confirm, in a fire situation, the maintenance of the integrity of the last filtration level.

The second intervention team may be required to intervene to manage various situations in a radiological environment such as a fire, chemical pollution, victim assistance or also an intervention of a physical protection nature.

The equipment of the second intervention team includes:

* for fire risk: similar to that of a professional firefighter (in particular fire jacket, helmets adapted for fire interventions and for other clearing-type interventions, insulated breathing apparatus);
* for chemical type interventions: NRBC type chemical outfit.

With regard to controlling the risks linked to fire, this second intervention team benefits from the equipment of the barracks rigged in a manner similar to that of a town of 30,000 inhabitants: two pump-type vans, two ambulances, a light command vehicle. In addition, means of reinforcement for routine or major intervention are available on cradles (pipes, pumps, generators, a chemical cradle, etc.), a mobile command post but also canine teams. For the record, in support, the establishment has a fire water network, permanently maintained under pressure of
7.5 bars and serving approximately 130 poles distributed on the site. These posts are capable of supplying additional pumps.

Having a dedicated emergency center for the establishment is a good practice. In addition, the entity has skills in the areas of multi-risk intervention, which is a real strength.

**Pool D - T0**

Concerning the first intervention team, in the same way, the time to carry out the first actions depends on the area in question. In any case, the time to reach this incriminated premises is reasonably less than that for the arrival of the second intervention team. These times are part of the criteria noted when carrying out the exercises and the times stated previously are average values. There is no regulatory intervention time and the demonstrations aim to define a set of measures for:

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**Silo 130**

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**Osiris**

In the event of a fire, the on-site fire brigade must be at the BNI in less than 10 minutes and must establish a mean of extinguishing with water in less than 20 minutes.

These response times correspond to a commitment taken by CEA toward ASN.

These response times are checked during exercices (center, unannounced, inspection, etc.).

**UNGG**

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As soon as the fire is confirmed, the emergency organisation is activated.

The regulatory requirement set out in Fire Decision 2014-DC-0417-1 sets out the obligation for fire responders to be trained and planned on an annual basis and adapted to their mission. (Articles 3.2.2-3 and 3.2.2-4). The measurement of the times achieved during these exercises makes it possible to ensure compliance with the time limits recalled in the previous points. Each site carries out an assessment of these exercises and trainings, including unannounced exercises, in order to define its adapted improvement and training program.

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As part of operational forecasting, the major possible fires led to the identification of 20 design-critical scenarios, which were examined jointly by all the SDIS's concerned. They cover all the major risks to which NPPs are exposed.

For each risk, the operational means necessary for fighting it have been defined. This generally concerns developed fires that are assumed to spread, necessitating the engagement of one or more levels of means (hydraulic means, fire engines, foam trailers, etc.).

These scenarios are regularly tested when preparing joint EDF/SDIS exercises.

For common events, the basis of organisation by phase remains identical, the licensee's means are always fully deployed, and the minimum first projection means to be deployed by the SDIS's are defined under their responsibility.

If not yet explained in the report, please clarify whether there is a fire brigade on site? If not yet done, please clarify how it is equipped (protection clothes and equipment, vehicules, ...).

**Tricastin**

The facilities are designed such that, in the event of fire, safety is maintained by a series of material provisions that suffice even without the intervention of the fire brigade. The development of a fire must nevertheless be controlled to limit the consequences for safety as well as for security, the environment and the assets.

Fire fighting is organised on the basis of Article 3.2.2-2 – Operational organisation of the appendix to Resolution 2014-DC- 0417 (Fire Resolution) and the identification of the different phases of fire-fighting organisation in line with the expected levels of defence.

Fire fighting in the NPPs is based on the seamless complementarity of action between the internal fire-fighting organisation (described in the following paragraph) and the Departmental Fire and Emergency Services (SDIS – Services Départementaux d'Incendie et Secours).

Refer to § A-I-3.2.1 (p115) “Overview of firefighting strategies, administrative arrangements and assurance”

**RHF**

In case of fire alarm, LIRT gets fitted with special clothes, helmet and autonomeous breathing system before going to check fire alarm location.

**UP3A-T2**

See previous answer

**Pool D - T0**

See previous answer

**Silo 130**

See previous answer

**Osiris**

In a nuclear environment, the on-site fire brigade mainly has :

* -Standardized firefighting clothes (according NF EN 469),
* -Isolated breathing apparatus,
* -Operational dosimetry (active and passive),
* -At least, two fire extinguishing vehicules and other related equipments (fire hoses etc.).

**UNGG**

The facilities are designed such that, in the event of fire, safety is maintained by a series of material provisions that suffice even without the intervention of the fire brigade. The development of a fire must nevertheless be controlled to limit the consequences for safety as well as for security, the environment and the assets.

Fire fighting is organised on the basis of Article 3.2.2-2 – Operational organisation of the appendix to Resolution 2014-DC- 0417 (Fire Resolution) and the identification of the different phases of fire-fighting organisation in line with the expected levels of defence.

Fire fighting in the NPPs is based on the seamless complementarity of action between the internal fire-fighting organisation (described in the following paragraph) and the Departmental Fire and Emergency Services (SDIS – Services Départementaux d'Incendie et Secours).

Refer to § F-II-3.2.1 (p198) “Overview of firefighting strategies, administrative arrangements and assurance”

Please clarify whether the onsite first intervention teams / onsite fire brigades have other day to day duties that could impact their availability for firefighting duties.

**Tricastin**

See previous answer

**RHF**

See answer to question FR-E-857.

**Silo 130**

The personnel defined to constitute an intervention picket may be called upon for a victim rescue or physical protection type mission. This type of hazard is of no consequence because it is possible to rig reinforcements according to need, particularly during the day.

**Osiris**

The on-site fire brigade workforce dedicated to firefighting missions has no other day to day duties that could impact their availability for firefighting.

**UNGG**

See previous answer

What evaluation has been carried out in order to adapt / modify the active fire protection strategy considering the evolution from operation to decommissioning (including changes in the new fire safety analysis, changes in fire loads, ignition sources, radiological environment, decommissioning activities, …)

**Osiris**

The transition from the operating to the decommissioning phase required a complete overhaul of the existing FSA and instructions, due to the change in activities (from a reactor in operation to decommissioning activities) and the reduction in staff numbers (security duty watch system was introduced after stopping the shift teams). It implied, by example, to adapt the strategy of nuclear ventilation management in fire situation to the risk and to the workforce.

**UNGG**

Analyses are carried out using envelope hypotheses that make it possible to manage changes in the risks associated with dismantling worksites. The means of active protection against fire may be adapted either through modification dossiers declared to or authorised by the ASN, depending on the needs of the dismantling worksites, or more generally during safety reviews.

## Licensee and regulatory experience

Please clarify whether you have any interesting operating experience feedback from testing fire detection and suppression systems.

**Tricastin**

Refer to A-I-3.2.4.1 “Overview of strengths and weaknesses” (p126) and to A-I-3.6.2.4.2 “Lessons learned from events, reviews fire safety related mission “ (p127) for further details.

**UP3A-T2**

Feedback from periodic checks of fire detection and extinguishing systems does not reveal any interesting points, apart from the possible case of an untimely release of extinguishing gas, but this does not concern the T2 workshop.

**Pool D - T0**

Feedback from periodic checks of fire detection and extinguishing systems does not reveal any interesting points, apart from the possible case of an untimely release of extinguishing gas, but this does not concern the Pool D workshop.

**Silo 130**

Feedback from periodic verification procedures for fire detection and extinguishing systems does not reveal any interesting points, apart from the possible case of an untimely release of extinguishing gas, but this does not concern the Silo 130 workshop.

In the specific case of silo 130, an ASN inspection made it possible to evaluate the time taken to implement the argon extinguishing of pit 43 manually during an exercise. As the implementation time was too long, the operator decided to carry out automatic argon extinguishing of
pit 43.

**Osiris**

The main experience feedback concerning the testing of fire detection and suppression systems of BNI 40 (OSIRIS) is described in chapter F-I-3.2.4.2 of the French national report.

Another point concerns the difficulties of testing detection or suppression systems installed in contaminated and irradiated environments such as hot cells.

**UNGG**

Refer to F-II-3.2.4.1 “Overview of strengths and weaknesses” (p201) and to F-II-3.2.4.2 “Lessons learned from events, reviews fire safety related mission “ (p201) for further details.

Please clarify what key learnings have been taken into account from past fire events in other NPPs.

**Tricastin**

Refer to A-I-3.2.4.1 “Overview of strengths and weaknesses” (p126) and to A-I-3.6.2.4.2 “Lessons learned from events, reviews fire safety related mission “ (p127) for further details.

**RHF**

Every fire event is reported and adressed as an abnormal event through an "Abnormal event Form". Depending on root causes analysis, corrective or improvement actions can be decided and further generalized to other sectors. For instance, a major decision made in the past years coming from this REX was to progressively extent as much as possible the fire detection system as it has been proved very effective.

1. OBE: Operating-Basis Earthquake [↑](#footnote-ref-1)
2. DBE: Design-Basis Earthquake [↑](#footnote-ref-2)
3. The operating basis earthcake corresponds to half of the sizing spectrum. The Design Spectrum(s) (DSS) is a standardised response spectra used in the seismic design of civil engineering structures and equipment. There may be several design spectra for an installation, for example, one for the generic part of the installation (repeatable over a period of time) and one for the site-specific part. [↑](#footnote-ref-3)
4. Safe Shutdown Earthquake (SSE): hypothetical earthquake producing an intensity on the site one degree greater (on the MSK scale) than that of the corresponding Maximum Historically Probable Earthquake (SMHV). The SMHV is the earthquake likely to produce the greatest effects on the site in terms of macroseismic intensity, and is defined by an analysis of historical observations, covering a period of around 1,000 years, and of geological and seismotectonic data for the region around the site. The SSE is the safety level of the seismic stress in the reference domain: a structure or component with a seismic resistance requirement must be capable of performing its function after an SSE. To achieve this, they are generally sized and qualified to the DSS. [↑](#footnote-ref-4)