

Post-Fukushima development of operating severe accident management and ERO



Vienna (Autriche) 19/03/2014



CHANGER L'ÉNERGIE ENSEMBLE



EDF **ACCIDENT GRAVE** **PRESCRIPTION**
F. 20 (FORMULE DE SECOURS - PLAN CLASSE 4 - INCIDENT CREATURES)

TOUS ETATS


(DOCUMENT EQUIPE LOCALE DE CRISE)

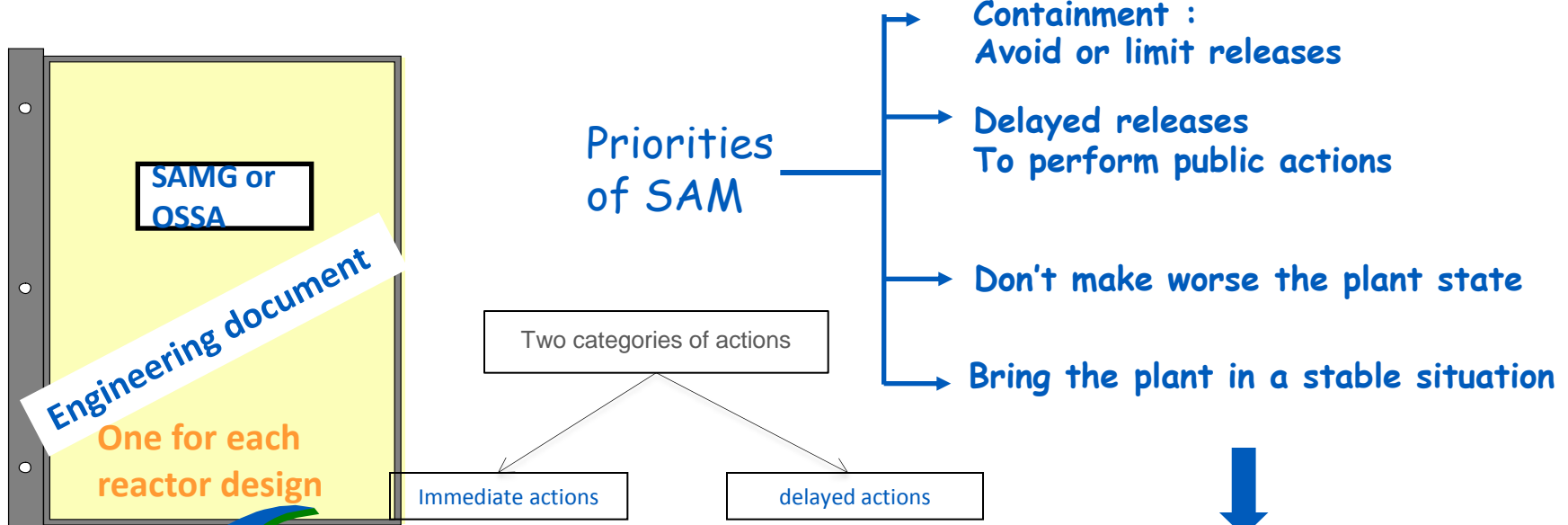
GIAG

C.S.	DEFINITION	DESCRIPTION	REVISION	DATE
01
02
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(Note: The table content is partially illegible due to image resolution.)

SEVERE ACCIDENT DEVELOPMENT IN THE LIGHT OF POST-FUKUSHIMA

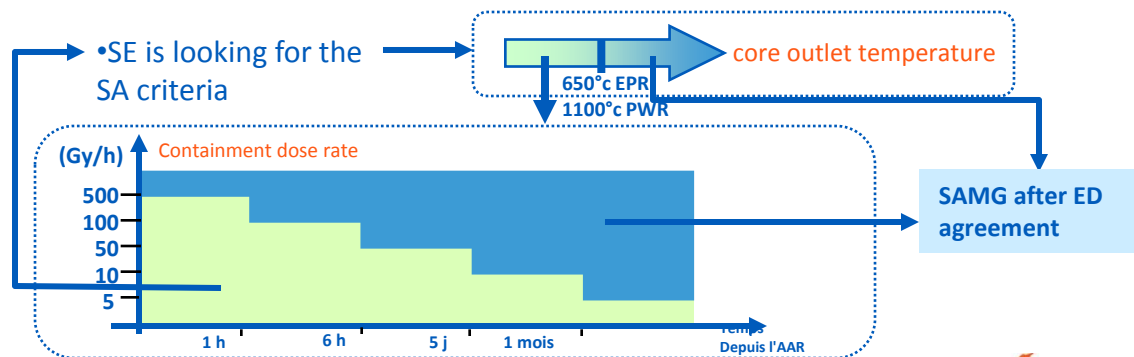
SEVERE ACCIDENT GUIDELINES



Beginning SAM actions early enough to guarantee SAM objectives (confinement protection and radioactive releases limitations)

Operational tools (SAMG) for:

- NTCC (National technical emergency center)
- LTC (Local technical emergency center)
- MCR (control room)
- ED (plant directors)



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POST-FUKUSHIMA :

Better preparation for unusual or new situations

- Implementation of new scenarios focused on these situations
- Reinforcing the Emergency Organization (FARN)
- Communications tools improvements
- **Severe accident management procedures**

EPR SAMG : under construction

- SAMG construction process implies Human Factors (HF) tests to verify the ability of

SAMG HF Evaluation

- ▶ First HF evaluation: 1st SAMG version, « static evaluation » in 2012 with the end users
 - Usability and utility of the procedures under construction
 - → HF recommendations
- ▶ 2nd HF evaluation: 2nd SAMG version, dynamic evaluation:
 - in a full scale simulator piloted by an instructor,
 - 3 scenarios performed by 1 operation team and the Emergency Preparedness (EP) personnel
- ▶ This HF evaluation involved
 - In the preparation phase HF experts, technical experts as instructors and others and designers in order to have a transverse view of the situation
 - In the realization phase HF & technical experts, different end users (team operation, EP personnel) that is 25 persons



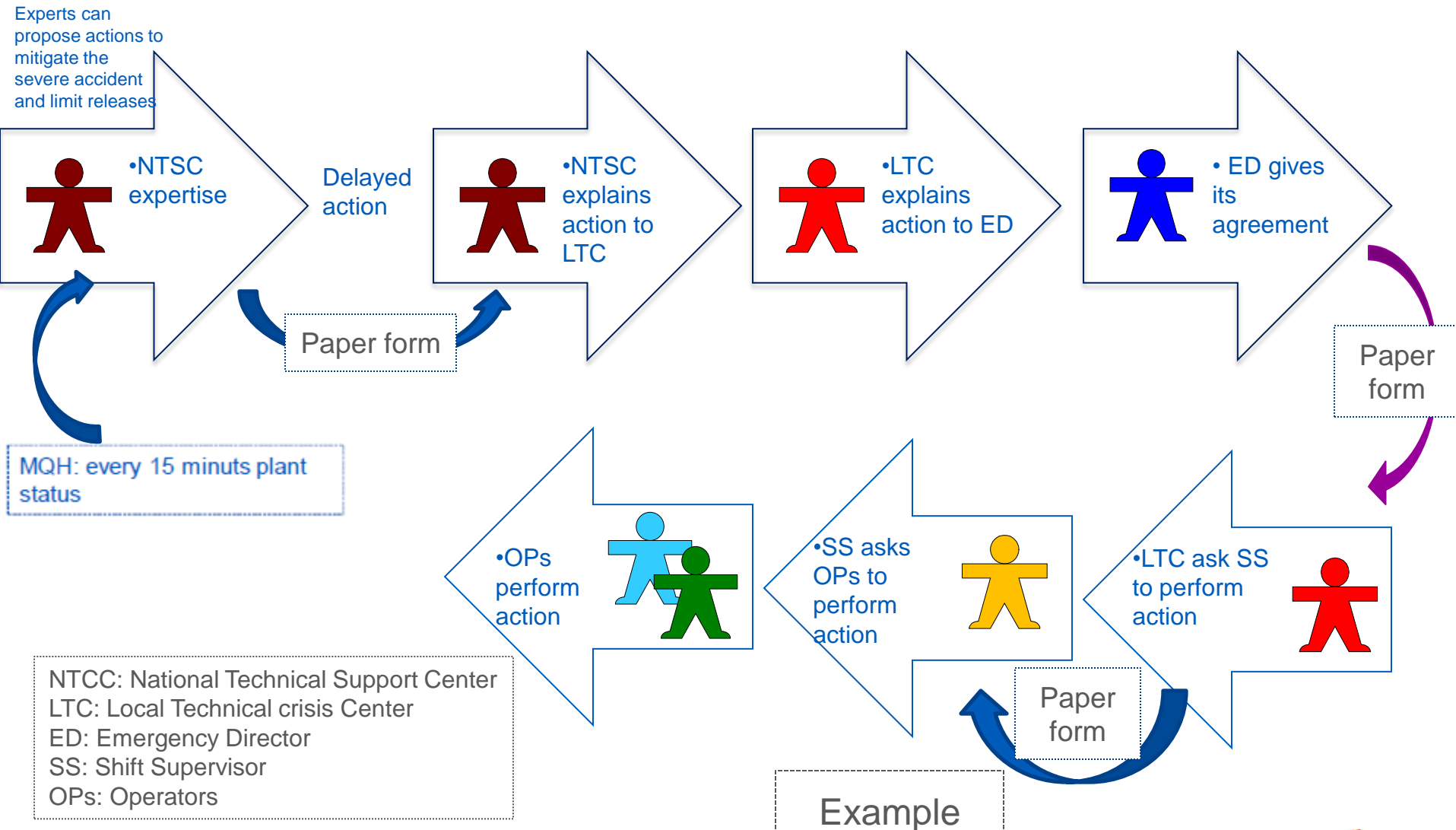
Some relevant points of the HF evaluation

- ▶ Feedback enabled,
 - to validate the SAMG evolution between the 1st and the 2nd evaluation:
 - Each actor is be able to apply their procedures
 - Procedures guide the actors, support the decision making process and the coordination between actors and different entities
 - To help the operation team and EP personnel to extend their knowledge of a severe accident and to test the continuity between emergency operating procedures and SAMG and to appreciate the differences and subtleties in the procedures
 - To make recommendations improving the decision making process, & supporting communication (identification of some key communication points)

*Demander à PCL 1 (Chef d'Exploitation) la réalisation de ces actions différées via le RFAG
fiche N° AG FM01 EC (Actions différées Gestion 1 file EDE, EBA, DCL)*

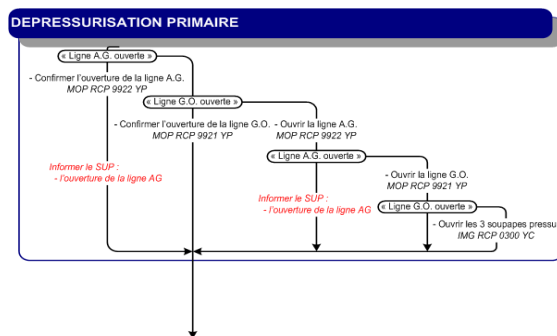
↳ Research program: “rebuilding communications network on damaged site”

Organization followed to perform a delayed action (analysis) has been reinforced by using papers forms/ MQH S.A. to communicate with the plant



Feedback

- to check the ability to implement actions identified in SAG, in a dynamic configuration
- instructions and actions in SAMG need to be clearly defined (pump n°, steps)



■ attention is paid to doses rates.

Research program: "how to acquire knowledge from the field to protect plant operators"

MS: EXEC03000

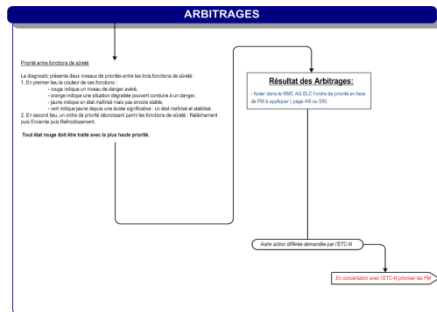
JEU INITIAL - BPE -

Suivi des actions locales et des agents de terrain en AG

DEMANDEUR (CICRER 401/00000000)	REPERAGE DE LA FICHE RECUEIL (CICRER 401/00000000)	N° DE FICHE	A COMPLETER PAR L'OPERATEUR ET PAR LE PCM				SUIVI		A COMPLETER PAR LE PCM (CICRER 401/00000000)	COMMENTAIRES
			TITRE DE LA FICHE	NOM DE L'EXECUTANT	LOCALITE D'INTERVENTION	COMPARTIMENT LOCALITE	LANCEE (h. min)	REUSSITE (h. min)		
		RFL RFLA RFL					LANCEE	REUSSITE		
		RFL RFLA RFL					RETOUR	ECHEC		
		RFL RFLA RFL					LANCEE	REUSSITE		
		RFL RFLA RFL					RETOUR	ECHEC		
		RFL RFLA RFL					LANCEE	REUSSITE		
		RFL RFLA RFL					RETOUR	ECHEC		
		RFL RFLA RFL					LANCEE	REUSSITE		
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		RFL RFLA RFL					RETOUR	ECHEC		
		RFL RFLA RFL					LANCEE	REUSSITE		
		RFL RFLA RFL					RETOUR	ECHEC		

Feedback

- ▶ Prioritize and re-prioritize rules for actions should be clearly defined before the accident. Indicate this prioritize in a support document.
 - Priority rules have been defined and the traceability has been reinforced for EPR.



Date/Heure de l'arbitrage: **Résultat des arbitrages:**

Noter l'ordre de priorisation (1,2,3...) en face des FM cochés lors du diagnostic

	Commentaires
FM01	
FM02	
FM03	
FM04	
FM05	
FM06	
FM07	
FM08	
FM09	
FM10	
FM11	

- The message form message to communicate from NTCC to the plant is currently under evolution to incorporate the priority

DATE:	HEURE:	N°:
REDACTEUR ELC:	SIGNATURE:	CONTRÔLEUR ELC:
		SIGNATURE:

DESTINATAIRE: PCL

DEMANDE ELC - ETC-N

CETTE ACTION EST AUTORISÉE PAR PCD 1

Les éléments suivants sont renvoyés par l'ELC d'après les résultats des expertises pour l'équipe de conduite

L'ÉQUIPE DE CONDUITE DOIT APPLIQUER LA STRATÉGIE SUIVANTE :

GESTION 2 FILLES EDE DEFALLANTES

FMS4 Arrêt des filles EDE

FMS8 Confirmer une file EDE en service

GESTION EVU

FMS3 C Trajet EVU n°1 en opération

FMS3 D Trajet EVU n°4 en opération

GESTION DE L'INJECTION DE SONDE VIA EVU

FMS3 E Max ES Injection soude via EVU train 1

FMS3 F Max ES Injection soude via EVU train 4

Cette demande est à renseigner par l'ELC en utilisant les éléments envoyés par l'ETC-N

Priority of this action regarding another one, to help NPP.

In conclusion, HF evaluation is an iterative process which aims are to:

- Take into account ergonomics guidelines: facilitate structuring of the information, guidance, contents, understanding
- Test procedures applicability in their context of use: team operation communication, interaction with EP personnel
- Test the coordination and synchronization adequacy of the severe accident operating actions (communication, decision making, information transmission....)

AND WHAT NEXT...

A training program for severe accident management using the simulator will be developed for the EPR

A 3rd HF evaluation is planned with the final version of the SAMG for an ultimate verification & validation of the evolution

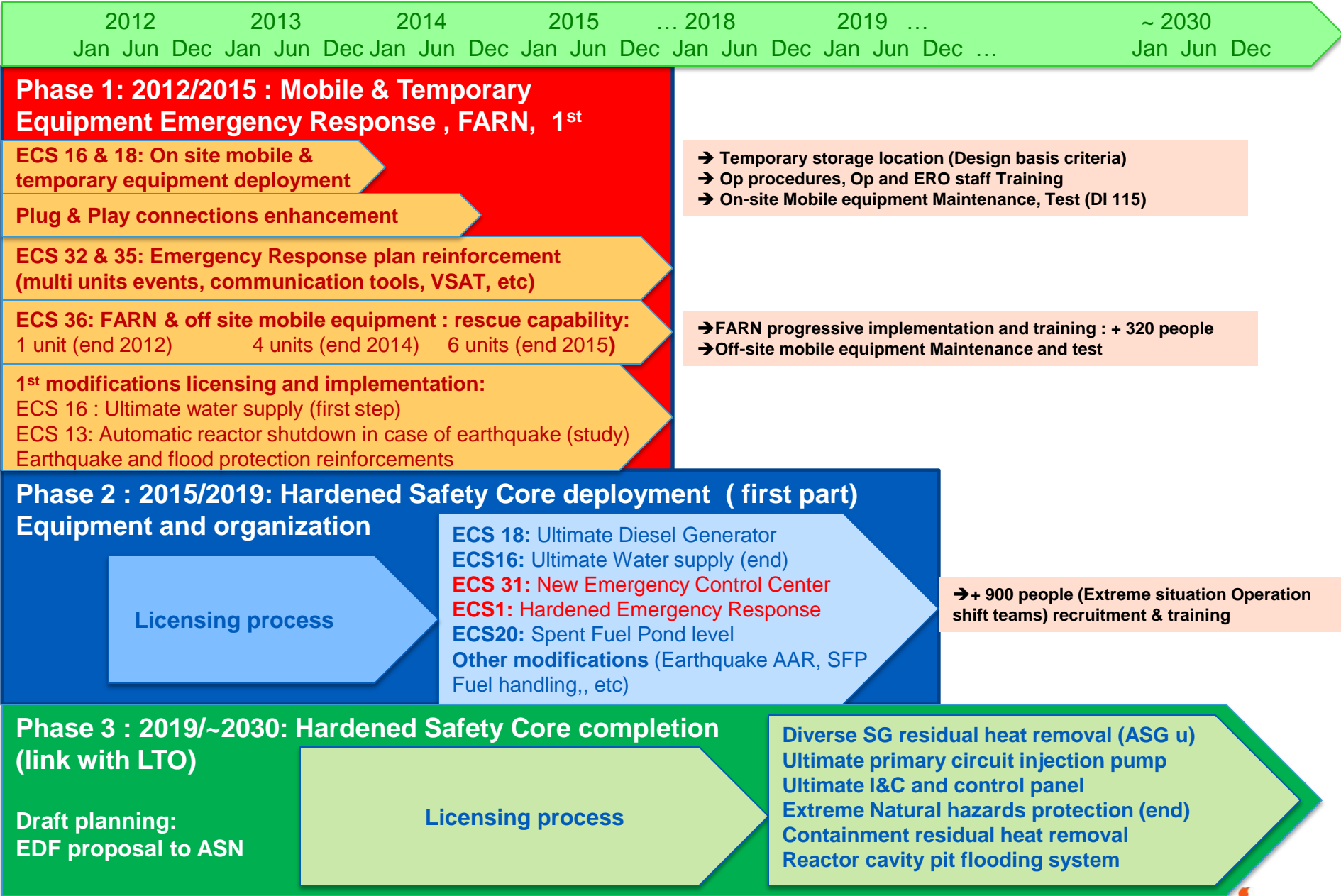
Implement new scenarios focused on severe accident situations on other PWR in France

Use this feedback and the feedback from other scenarios to continue to improve our SAMG



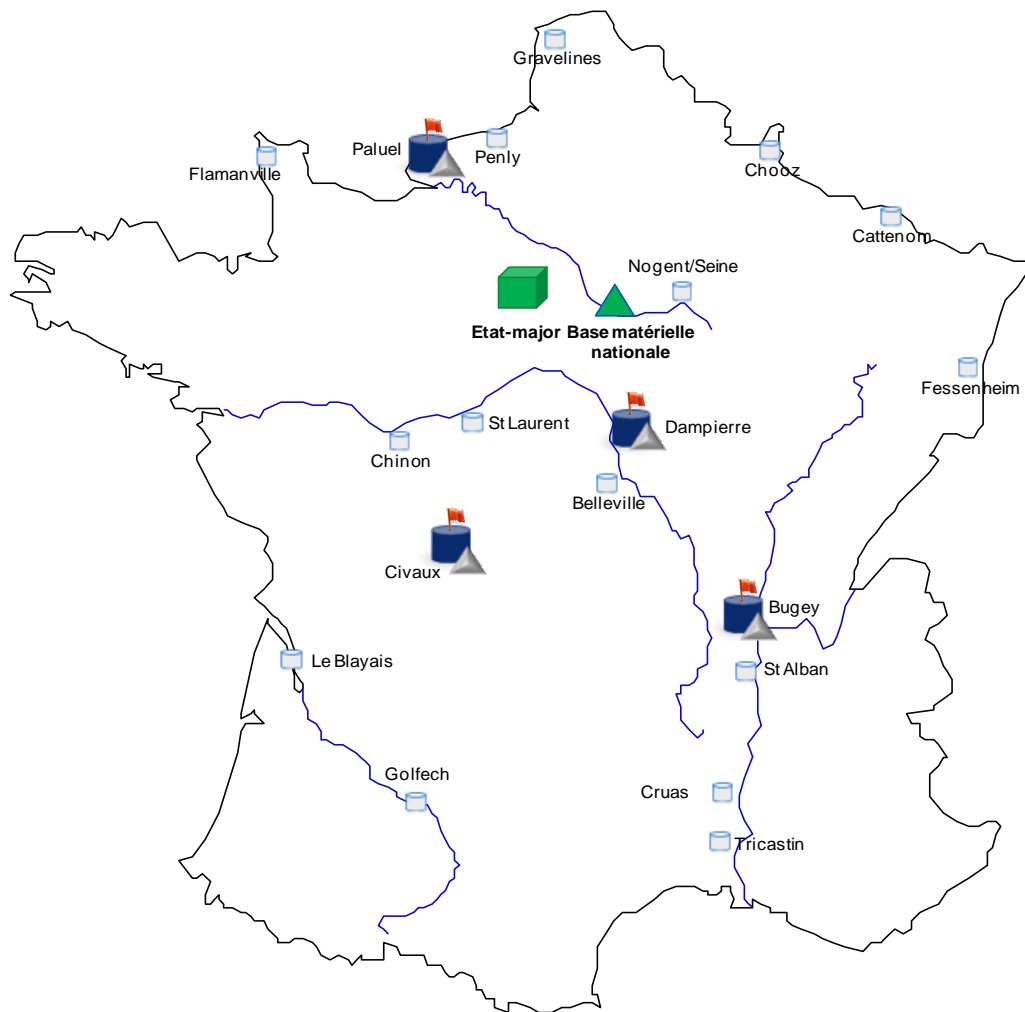
EMERGENCY RESPONSE PLAN TO FUKUSHIMA

EDF post Fukushima Action plan : 3 phases of deployment & ASN requirements



ORGANIZATION OF THE NUCLEAR RAPID RESPONSE FORCE (FARN)

1. two-level organization → national and regional



1 national FARN headquarters

(reconnaissance team, about 30 people in 5 on-call teams, country-wide intervention)

1 national equipment base

(long-term equipment, rear bases modules)

4 regional FARN Human Resources bases with regional equipment bases nearby

hosted by 4 NPPs (Civaux, Dampierre, Paluel, Bugey)
(about 4 x 70 people in 5 teams of 14 on-call people each, country wide intervention)

4 local rear bases

predefined for each of the 19 NPPs

(one to be chosen in case of severe situation at a NPP)

Intervention of the FARN in case of external severe situation

► Objectives of the FARN

- To arrive on a site in accident conditions within 12h in order to :
 - Bring skilled operators on site in order to help the local shift, and possibly take-over.
 - If existing on site equipment is no more available, supply additional electricity, water and compressed air with own mobile equipment (stored and transported by the FARN) : connect, start and operate it , to ensure permanent core and spent fuel pool cooling
 - Ensure supply chain and technical support (with own logistic means stored and transported by the FARN)
- To be fully operational on a site in accident conditions within 24h.
- Avoid releases in the environment
- Avoid, as much as possible, any core melt

Intervention of the FARN in case of external severe situation

► Functions that FARN will re-supply with

- Water (i.e. Emergency Feed-water Tank, Spent Fuel Pool, Reactor Water Storage Tank) → **Mobile autonomous Pumps**
- Electricity (i.e. I&C, lighting) → **Mobile autonomous EDG's**
- Air (i.e. Atmosphere Steam Generators discharge valves, Emergency Feed-water Turbine-driven pump) → **Mobile autonomous air compressors**
- **Fuel oil + all logistic**

► Progressive plugging points deployment plan :

- from end 2012 to end 2014, use off the existing plugging points located on existing installations to **feed** the safety functions with mobile equipment :
- for end of 2014 : installation of new standardized plugging points on each site.
- From 2014 to end of 2018 : definitive plugging points consistent with « hard core» safety equipment extreme hazards resilience criteria (Ultimate Diesel Generators, Ultimate Heat Sink)

Intervention of the FARN in case of external severe situation

► The site and the FARN will assure an autonomy at least of 72 hours and the durability of the safe situation after 72 hours

► **for $t < 24h$ after the event : the safety has to be guaranteed by the local teams and the local means**

Utilization of the existing site fixed equipment remained available, and implementation on each unit of the site of local mobile or temporary equipment (Local Crisis Means = MLC), to be deployed by the teams of the site and allowing them, to guarantee a site autonomy of at least 24 hours

► **for $t > 24h$ after the mobilization of the FARN, till 72h: the safety is guaranteed by the local teams and the FARN in total autonomy:**

The FARN (Rapid Nuclear Response Force, with its own dedicated human resources and dedicated mobile equipment, available at the regional level (Regional Crisis Means = MRC) or at the national level (National Crisis Means = MNC), will supply the site to guarantee a site + FARN autonomy of at least 72 hours

► **for $t > 72h$ after the mobilization of the FARN: the durability of a safe situation is guaranteed by the site and the FARN organisation helped by the EDF Group additional resources**

The site and the FARN will be supplied by additional resources of the EDF Group, and if necessary, with mobile equipment shared between the French Nuclear Operators (AREVA, CEA, EDF) (GIE Intra), to guarantee the durability of the safe situation

Decide the training depending on the actors and their missions

- ▶ Study is ongoing with technical experts from different entities
- ▶ A personnel mapping is under construction in order to:
 - Identify the actors involved in stressful situations
 - Characterize their eventual stressful activity and the means and resources available to perform their missions
 - Identify the actors needing a specific training
 - Choose an adapted training and develop the program
- ▶ Train people to face unknown situations, train to manage unexpected situations
 - Combine simulation and Story telling: exchange practices, ideas and imagine new solutions
 - Use relaxation techniques help to take stock of the critical situation and be able to rebuild again & again, to have a better view..
 - → That is to change the philosophy of training previously based on applying procedures, and add the point of view of the “adaptation” by the workers to the uncertainty....

Preparing the operation team and other populations to deal with stressful situations

- ◆ A study in collaboration with the HF services of the army in order to identify a range of tools that can be used to prepare populations to deal with stressful situations
- ◆ Develop a model of understanding, with the human reliability experts, taking into account the stressful activity from a cognitive point of view, and the individual and team performance interacting with the control means and local and national emergency operation

→ Anticipation of the management of categories of normal & accidental situations

Procedures, training, human & training resources, organization, material resources

Pay attention to the present

What happened?
→ Refine an existing strategy depending on the resources available and the current situation
→ Identify differences from the “ordinary” situation?

→ Adaptation of the means (cognitive & organizational)

Analysis of the “extraordinary” situation
Improvisation of skills
Improvisation of an organization

→ Resilience

To construct a new response with intentional & automatic processes

Titre de la présentation | mm/aaaa