Enhancing the Emergency Preparedness and Response Expertise with the Use of Advanced Response and Assistance Network Capabilities

IRSN
INSTITUT DE RADIOPROTECTION ET DE SÛRETÉ NUCLÉAIRE

Faire avancer la sûreté nucléaire

O. Isnard
IRSN
Radiation Protection Division – Emergency
Emergency Response Department

RANET: Response and Assistance Network

RANET is an operational tool under the Assistance Convention which aims at facilitate:

- The provision of requested international assistance
- The harmonization of emergency assistance capabilities and,
- The relevant exchange of information and feedback of experience

IAEA Action plan on Nuclear Safety which gives a new mandate to the Agency regarding the provision of information to MS and the general public during a nuclear emergency on its potential consequences, including available information and prognosis of possible scenarios…

RANET: Response and Assistance Network

8 functional areas including:

- Radiological Assessment and Advice
  - Atmospheric Dispersion
  - Dose prediction…
- Nuclear Installation Assessment and Advice
  - Nuclear Power Reactor Accident Analysis
  - Spent Fuel Storage Assessment and Advice…

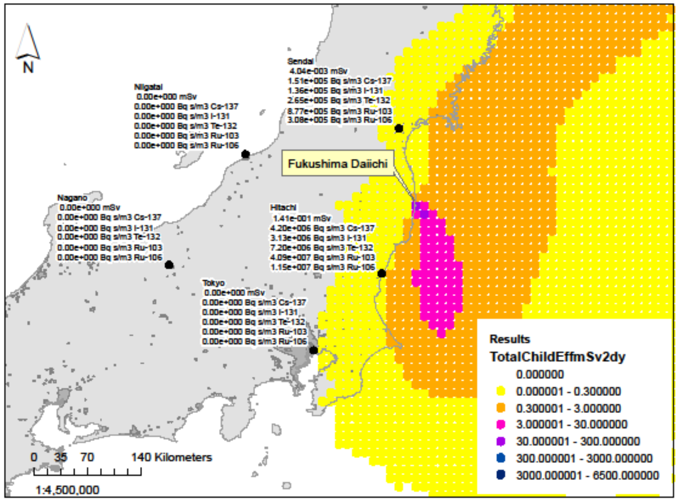
The IEC (Incident and Emergency Centre) aims at developing an Assessment and Prognosis process to fulfill the new mandate

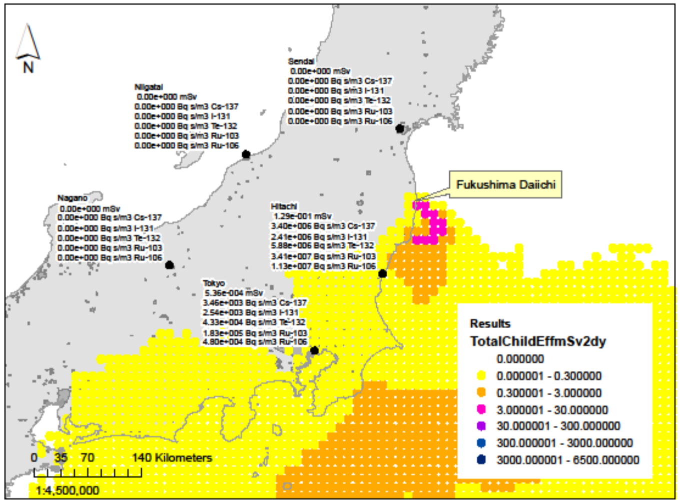
An accident somewhere is an accident everywhere

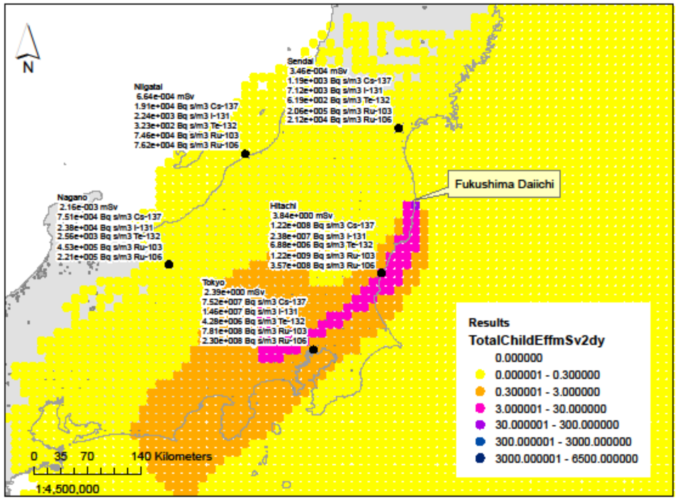
During the response to the Fukushima emergency (all) MS with expertise capabilities where providing analysis and anticipation scenarios to their strategic/decision level.

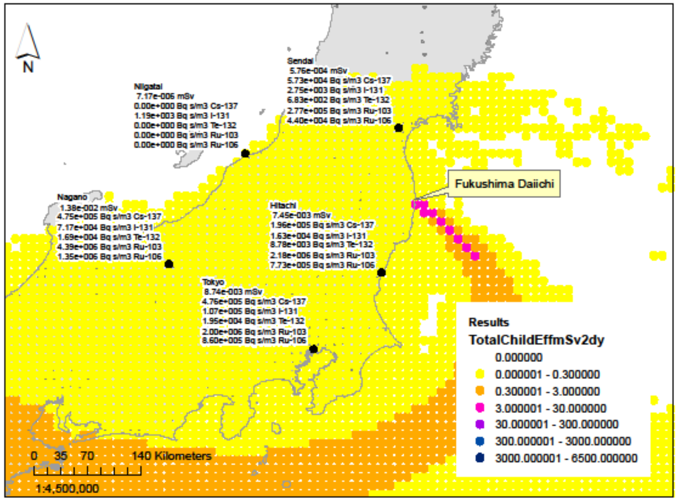
- Using pre-calculated source terms (unit, scenario based, real-world accident)
- Using live calculated source terms from analysed data from TEPCO public data available (diagnostic and prognostic)
- Using their National Meteorological Services for weather forecasts at different scale
- Using their national response system (models) for atmospheric transport and for dose assessments

UK (PHE, RIMNET & Met. Off.)









Russia (IBRAE)

ТЕХНИЧЕСКИЙ КРИЗИСНЫЙ ЦЕНТР
ИНСТИТУТ ПРОБЛЕМ БЕЗОПАСНОГО РАЗВИТИЯ АТОМНОЙ ЭНЕРГЕТИКИ

Оперативному дежурному СКЦ Росатома
Срочно для Генерального директора Госкорпорации «Росатом»
Кириенко С.В.
Копию – заместителю генерального директора Госкорпорации «Росатом» Локшину А.М.
Копию –директору Департамента коммуникаций Госкорпорации «Росатом» Новикову С.Г.

12/03/11
СПРАВКА № 9
19:30

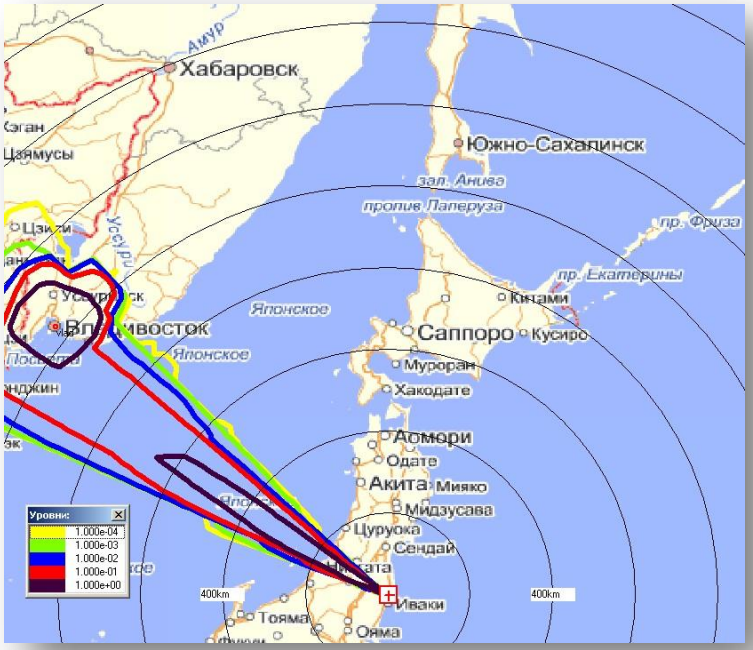
ДЛЯ ИНФОРМАЦИИ! СРОЧНО!

Расчетный анализ консервативного по сценарию протекания аварии на АЭС с максимальными значениями (малореалистичными) возможного выброса с неблагоприятными метеоусловиями с направлением переноса облака к территории Российской Федерации (расчетная точка – г.Владивосток), выполненной в ИБРАЭ РАН, показывает, что прогнозируемые дозы облучения даже в случае выпадения осадков над территорией г.Владивостока значительно меньше значений, представляющих сколь-либо значимый ущерб здоровью и не требуют каких-либо мер вмешательства.

Максимальная аварийная доза при абсолютно нереалистичных предположениях возможной величины выброса будет составлять 10 мЗв за год. Мощность дозы при этом кратковременно может возрастать до 20-30 фоновых значений, т.е 2-3 мкЗв/ч (200 – 300 мкР/ч).
С помощью модуля БОНУС 2.1 в составе кода СОКРАТ проведены предварительные оценки накопления нуклидов во время нормальной эксплуатации АЭС Fukushima Daiici (блок № 1).
В таблице 1 приведены параметры активной зоны реактора при которых проводились расчеты.

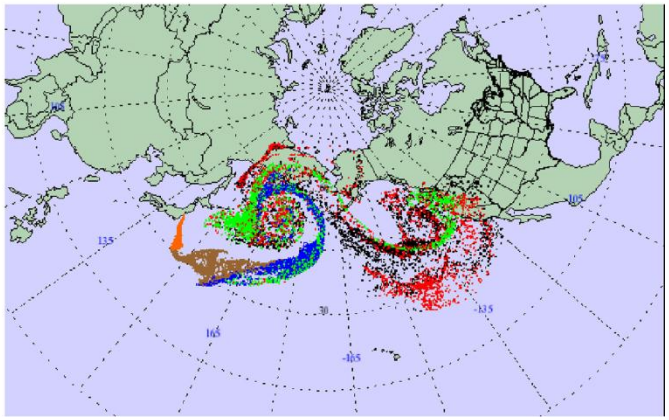
The worst (unlikely) weather conditions have been chosen for calculation:

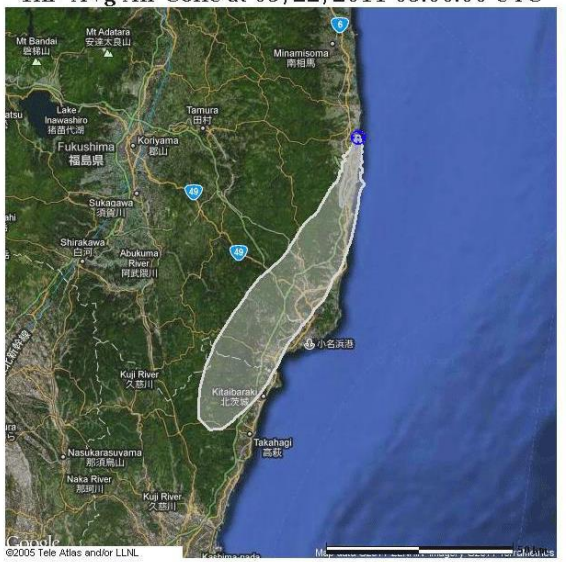
Wind speed – 10 m/s,
Wind direction - 115 degrees,
Stability category – E,
Local precipitations in the Vladivostok area at the rate of 10 mm/h.

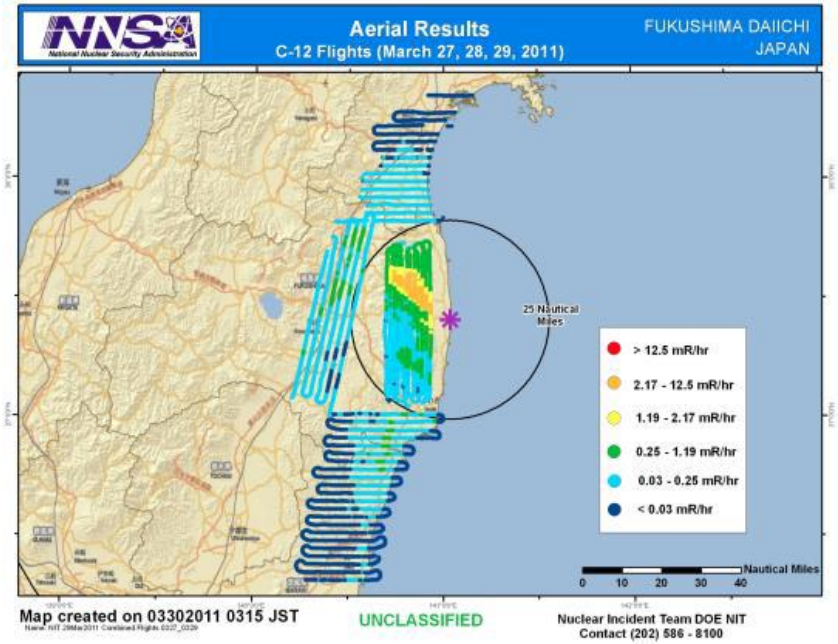


Total annual effective dose (children of 1-2 years) within 10 mSv

USA (US-NRC & US-DOE: NARAC)







France (IRSN)

IRSN
INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

22 mars 2011

L'IRSN publie une évaluation de la radioactivité rejetée par la centrale de Fukushima Daiichi (Fukushima I) jusqu'au 22 mars 2011

Annexe

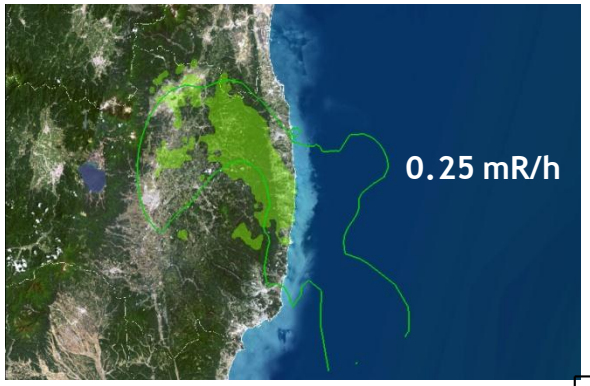
Composition détaillée du rejet utilisé pour estimer les niveaux de contamination de l'air

Isotope	Cumul (Bq)
Kr-85	2 E+16
Kr-85m	1 E+14
Kr-87	7 E+11
Kr-88	5 E+13
Xe-133	2 E+18
Xe-133m	2 E+16
Xe-135	2 E+16
Xe-138	9 E+01
Kr-83m	1 E+13
Xe-131m	2 E+16
Xe-135m	6 E+14

Isotope	Cumul (Bq)
I-131	9 E+16
I-132	7 E+16
I-133	2 E+16
I-134	4 E+11
I-135	2 E+15
I-129	2 E+09
I-132m	2 E+10
I-128	4 E+04
I-130	5 E+13

Isotope	Cumul (Bq)
Cs-134	1 E+16
Cs-136	6 E+15
Cs-137	1 E+16
Cs-138	3 E+09
Cs-134m	1 E+12

Isotope	Cumul (Bq)
Rb-88	5 E+13
Rb-89	3 E+02
Te-133m	4 E+10
Te-134	6 E+09
Sb-130	1 E-15
Sb-125	6 E+14
Sb-127	4 E+15
Sb-128	1 E+10
Te-127	5 E+15
Sb-128m	1 E+13
Sb-129	4 E+13
Te-129m	7 E+15
Sb-131	8 E+05
Te-125m	1 E+14
Te-132	6 E+16
Te-127m	1 E+15
Te-131	5 E+14
Te-131m	2 E+15
Te-133	7 E+09
Br-83	2 E+12
Br-84	7 E+07



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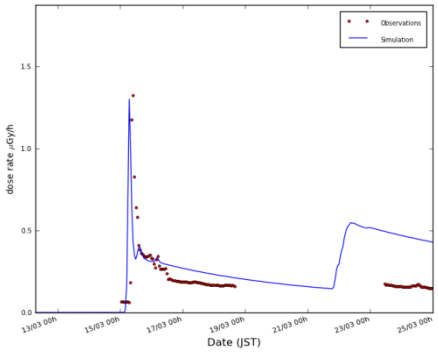

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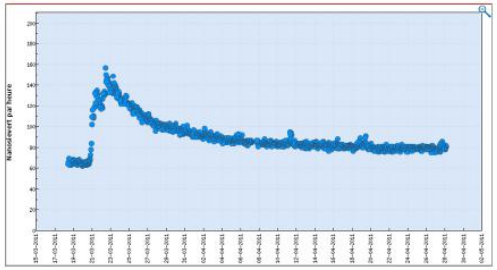

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Most (if not all) of these expertise were done without any exchange

Mainly because objectives were different

- **Protection of national residents living in Japan (Tokyo)**
- Planning of ground (or airborne) missions (rescues, monitoring…)
- Planning and response to plume arrival (monitoring) on MS territory
- Domestic public communication including evaluation of health impact on MS territory
- None (almost) where devoted to look at the protection of local population around the Fukushima plant

Data needed to provide expertise (for domestic use and as a RANET asset) shall be organized and distributed trough a centralized system

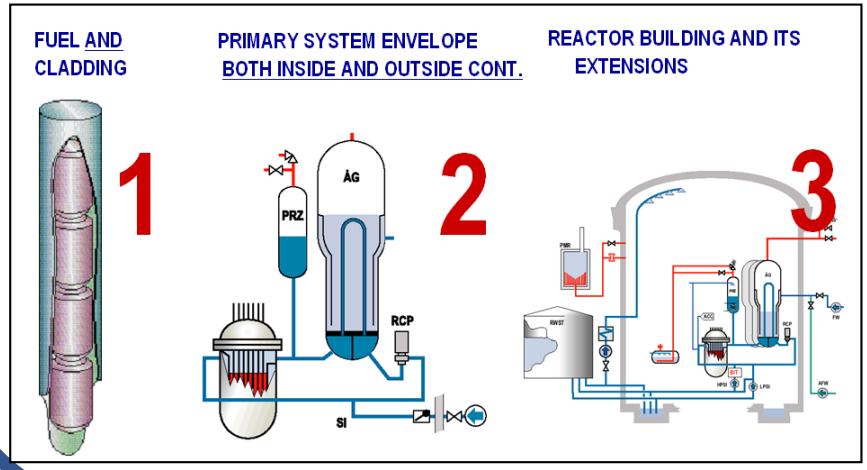
The Fukushima accident showed that at some point, the accident state must provide raw data of the on-going accident (installation, environment) to let expertise assets throughout the world use them for their own analysis (needed by MS to take strategic decisions)

- **Avoid too much transfer is of paramount importance to minimize effort from the accident state and to insure consistency of distributed data**
- Accident related data
  - Dynamic data from the impacted nuclear installation
  - Environmental monitoring data on and off-site
- Meteorological data
  - Forecasts at different temporal resolution and spatial scales
  - Observation and Nowcast products

What for?

Enhancing the understanding of the situation is done trough the use of a structured methodology providing a regular diagnostic of the state of the accident installation.
Anticipation on possible scenarios and development of the accident shall also be done with the help of a structured methodology

The IRSN methodology (3D/3P) structure the work of expertise resources, facilitate the dialogue and the exchange of information between expertise teams and **does not require numerous data to work !**

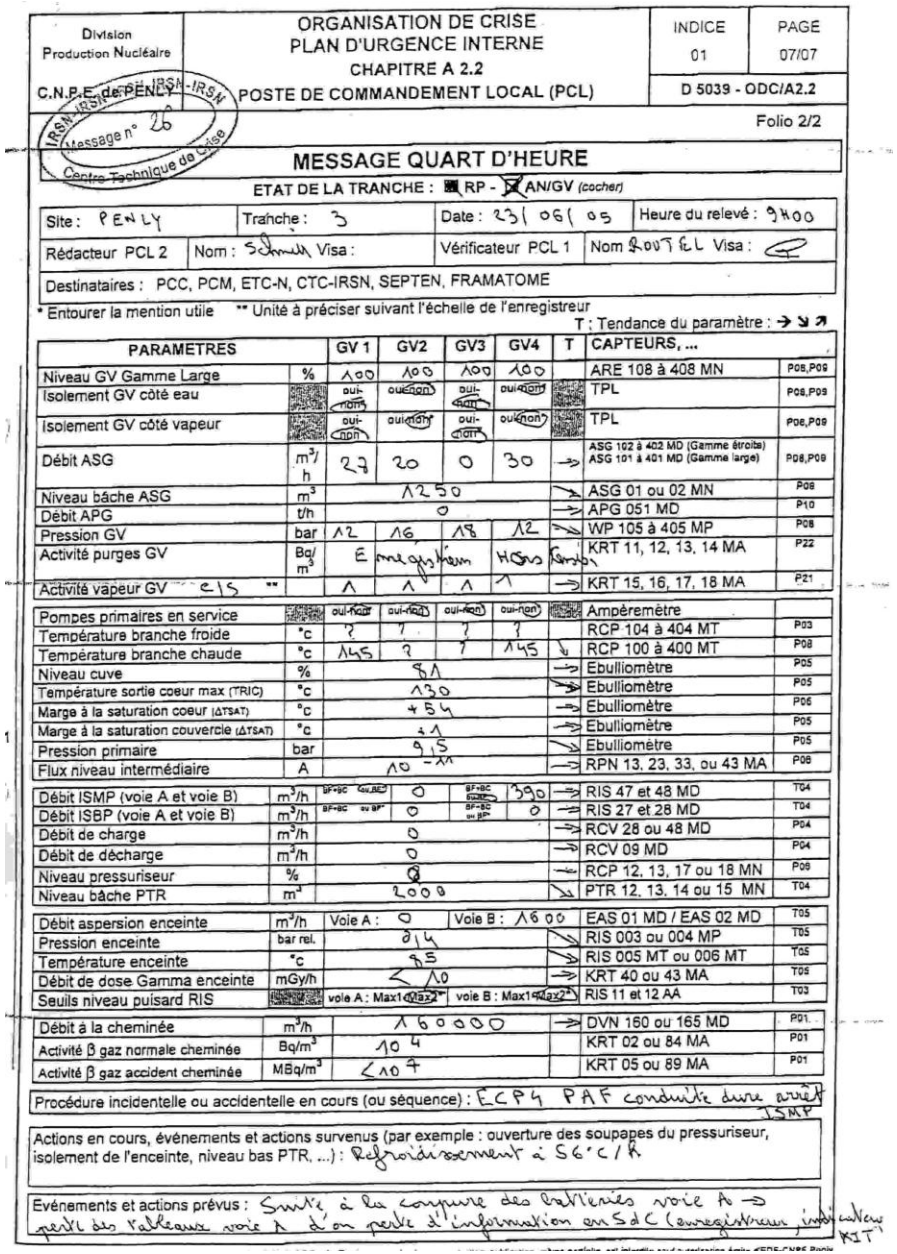


COUNTRY	NPP SITE	NPP UNIT	COORDINATES LONG/LAT	REACTOR TYPE	DATE	LOCAL TIME	GMT TIME
FRANCE	GRAVELINES	1	0 / 50	Generic PWR			

STATUS at 15 h 54	DIAGNOSIS		PROGNOSIS		
Barriers Status	Safety functions status	Systems used for the monitoring of functions	Forecast availability of systems	Forecast status of safety functions	Forecast Status of Barriers
Fuel Matrix and Claddings	• confortable • low • doubtful	• control rods • boration: SI, chemical & vol. ctrl sys, makeup, FBA	• confortable • low • doubtful	• control rods • boration: SI, chemical & vol. ctrl sys, makeup, FBA	**Fuel Matrix and Claddings** **No cladding Failure** ☐ **Cladding Failure** ☐ **Core Melt** at h ☐
No cladding Failure ☐ **Cladding Failure** ☐ **Core Melt** ☐	• satisfactory • degraded • dewatering • doubtful	• SI, chemical & vol. ctrl • water reserves (RWST, makeup)	• satisfactory • degraded • dewatering • doubtful	• SI, chemical & vol. ctrl • water reserves (RWST, makeup)	
Primary System **Integral** ☐ **Doubtful** ☐ **Primary break** ☐ ☐ inside reactor building ☐ PZR relief lines ☐ outside containment ☐ SGTR	• controlled or not • adequate or not • doubtful	• SG • break • SI • feed and bleed • Decay heat and Removal system • Component Cooling sys. • Essential Service Water system	• controlled or not • adequate or not • doubtful	• SG • break • SI • feed and bleed • Decay heat and Removal system • Component Cooling sys. • Essential Service Water system	**Primary System** **Integral** ☐ **Doubtful** ☐ **Primary break** ☐ ☐ PZR relief lines opened at h ☐ Outside containment ☐ SGTR
Reactor Building and its Extension **Normal Leakage** ☐ **Doubtful** ☐ **Uncollected leakage** ☐ ☐ penetrations ☐ IRWST ☐ secondary system **Collected leakage** ☐ ☐ RB penetration ☐ connected system **RB depressurization** ☐	• safe • not guaranteed • doubtful	• containment isolation phases 1 and 2 • containment spray • system in service	• safe • not guaranteed • doubtful	• containment isolation phases 1 and 2 • containment spray • system in service	**Reactor Building and its Extension** **Normal leakage** ☐ **Doubtful** ☐ **Uncollected leakage** ☐ ☐ penetrations ☐ IRWST ☐ secondary **Collected leakage** ☐ ☐ RB penetration ☐ connected system isolated at h **RB depressurization** at h ☐

Example of simple data exchange between the operator and IRSN Technical Emergency Centre

- Need to establish at the preparedness phase the data to be exchanged
- Automatic data transmission is preferable
  - Allow to run expertise in parallel
  - Does not require extra resources from the operator



Division Production Nucléaire
C.N.P.E. de PENLY

ORGANISATION DE CRISE
PLAN D'URGENCE INTERNE
CHAPITRE A 2.2
POSTE DE COMMANDEMENT LOCAL (PCL)

INDICE 01 | PAGE 07/07
D 5039 - ODC/A2.2
Folio 2/2

IRSN-IRSN-IRSN Message n° 26 Centre Technique de Crise

MESSAGE QUART D'HEURE

ETAT DE LA TRANCHE : RP - AN/GV (cocher)

Site : PENLY | Tranche : 3 | Date : 23/06/05 | Heure du relevé : 9H00
Rédacteur PCL 2 | Nom : Schmitt Visa : | Vérificateur PCL 1 | Nom ROUTEL Visa :
Destinataires : PCC, PCM, ETC-N, CTC-IRSN, SEPTEN, FRAMATOME

* Entourer la mention utile ** Unité à préciser suivant l'échelle de l'enregistreur
T : Tendance du paramètre : → ↘ ↗

PARAMETRES		GV 1	GV2	GV3	GV4	T	CAPTEURS, ...	
Niveau GV Gamme Large	%	100	100	100	100		ARE 108 à 408 MN	P08,P09
Isolement GV côté eau		oui-non	oui-non	oui-non	oui-non		TPL	P08,P09
Isolement GV côté vapeur		oui-non	oui-non	oui-non	oui-non		TPL	P08,P09
Débit ASG	m^3/h	27	20	0	30	→	ASG 102 à 402 MD (Gamme étroite) ASG 101 à 401 MD (Gamme large)	P08,P09
Niveau bâche ASG	m^3	1250				↘	ASG 01 ou 02 MN	P08
Débit APG	t/h	0				→	APG 051 MD	P10
Pression GV	bar	12	16	18	12	→	WP 105 à 405 MP	P08
Activité purges GV	Bq/m^3	E			Hors	→	KRT 11, 12, 13, 14 MA	P22
Activité vapeur GV **		1	1	1	1	→	KRT 15, 16, 17, 18 MA	P21
Pompes primaires en service		oui-non	oui-non	oui-non	oui-non		Ampèremètre	
Température branche froide	°c	?	?	?	?		RCP 104 à 404 MT	P03
Température branche chaude	°c	145	?	?	145	↘	RCP 100 à 400 MT	P08
Niveau cuve	%	81				→	Ebulliomètre	P05
Température sortie coeur max (TRIC)	°c	130				↘	Ebulliomètre	P05
Marge à la saturation coeur (ΔTSAT)	°c	+54				→	Ebulliomètre	P06
Marge à la saturation couvercle (ΔTSAT)	°c	+1				→	Ebulliomètre	P05
Pression primaire	bar	9,5				↘	Ebulliomètre	P05
Flux niveau intermédiaire	A	10 -11				→	RPN 13, 23, 33, ou 43 MA	P08
Débit ISMP (voie A et voie B)	m^3/h	BF+BC ou BAS	0	BF+BC ou BAS	390	→	RIS 47 et 48 MD	T04
Débit ISBP (voie A et voie B)	m^3/h	BF+BC ou BF	0	BF+BC ou BF	0	→	RIS 27 et 28 MD	T04
Débit de charge	m^3/h	0				→	RCV 28 ou 48 MD	P04
Débit de décharge	m^3/h	0				→	RCV 09 MD	P04
Niveau pressuriseur	%	Ø				→	RCP 12, 13, 17 ou 18 MN	P08
Niveau bâche PTR	m^3	2000				↘	PTR 12, 13, 14 ou 15 MN	T04
Débit aspersion enceinte	m^3/h	Voie A : 0		Voie B : 1600		↘	EAS 01 MD / EAS 02 MD	T05
Pression enceinte	bar rel.	0,4				→	RIS 003 ou 004 MP	T05
Température enceinte	°c	95				→	RIS 005 MT ou 006 MT	T05
Débit de dose Gamma enceinte	mGy/h	< 10				→	KRT 40 ou 43 MA	T05
Seuils niveau puisard RIS		voie A : Max1 Max2		voie B : Max1 Max2		→	RIS 11 et 12 AA	T03
Débit à la cheminée	m^3/h	160000				→	DVN 160 ou 165 MD	P01
Activité β gaz normale cheminée	Bq/m^3	10^4					KRT 02 ou 84 MA	P01
Activité β gaz accident cheminée	MBq/m^3	$< 10^4$					KRT 05 ou 89 MA	P01

Procédure incidentelle ou accidentelle en cours (ou séquence) : ECP4 PAF conduite dure arrêt ISMP

Actions en cours, événements et actions survenus (par exemple : ouverture des soupapes du pressuriseur, isolement de l'enceinte, niveau bas PTR, ...) : Refroidissement à 56°C/h

Evénements et actions prévus : Suite à la coupure des batteries voie A → perte des rateaux voie A d'où perte d'information en SdC (enregistreurs, indicateurs KIT)

Most of the advanced centers which provide nationally expertise on radiological consequences during response are not meteorological services, they are able to run operational models which evaluate the atmospheric dispersion processes and the various doses for the public and consequences for the environment.

Their arrangements with national meteorological services make available weather forecasts to them to be in a position to do Radiological Assessment

Providing assistance as a RANET asset require to have access to “best” weather forecast products possible in the impacted area but also world-wide.

WMO shall organize RMSCs to provide such meteorological products to IAEA which will then broadcast them to RANET assets in charge of Radiological Assessment and Advice.

Contribution from different organizations to the Assessment and Prognosis process will enhance the global capabilities to be in a position to understand a developing situation and resulting possible consequences

The provision of several Assessment and Advice to the IAEA/IEC during a response will enable the IEC to combine results to produced concerted messages with the Accident State.

In doing so, the IEC will stay at a strategic level providing to MS a global overview of the situation and possible developments, enabling requesting MS to plan and to implement adequate responses to the situation

The Assessment and Prognosis process is achievable if potential Accident State commit to provide the necessary technical data (dynamic measurements in the installation) and if WMO and IAEA put in place an mechanism for RANET assets to get access to meteorological forecast products

- Extension of existing expertise methodologies to all type reactors
- Improve reference codes for Severe Accident (source term model), including the improvement of Iodine behaviour models

- Provision of operational ensemble forecasts
- Improve wind direction forecast at small scale and ‘Nowcast’ products (including rain radar)

- Improve multi-scale atmospheric dispersion models (including deposition) and chemistry models for iodine in the atmosphere
- Improve of Data Assimilation methodology on environmental measurements (retrieve of source terms)