
Use of ISOE for the assessment of the RP practices at ENGIE Electrabel

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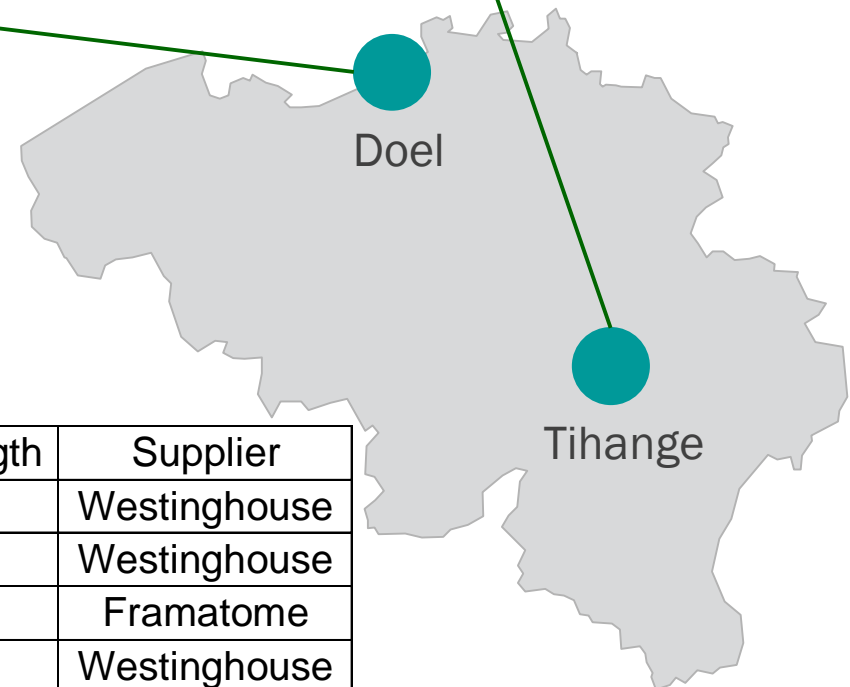
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INSO at ENGIE
Electrabel



ENGIE Electrabel Belgian NPP's

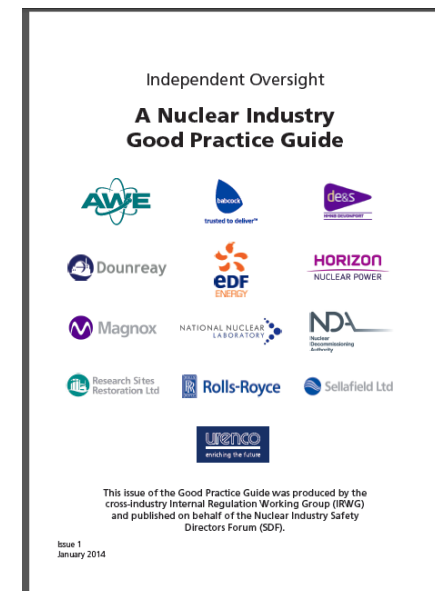
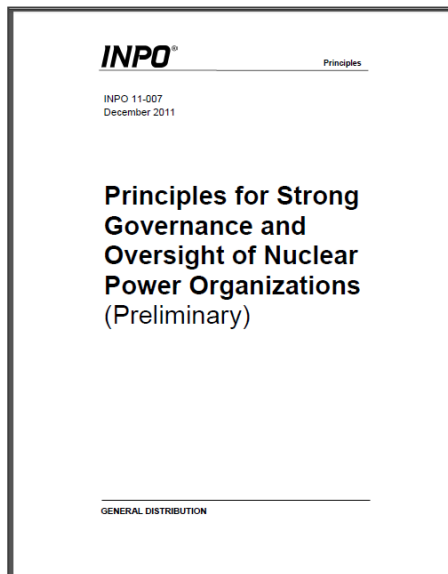


| NPP | P (MWe) | Year | Cycle length | Supplier |
|-----------|---------|------|--------------|--------------|
| Doel 1 | 440 | 1975 | 12 m | Westinghouse |
| Doel 2 | 440 | 1975 | 12 m | Westinghouse |
| Doel 3 | 1030 | 1983 | 12 m | Framatome |
| Doel 4 | 1030 | 1985 | 18 m | Westinghouse |
| Tihange 1 | 1000 | 1975 | 18 m | Westinghouse |
| Tihange 2 | 1030 | 1983 | 18 m | Framatome |
| Tihange 3 | 1030 | 1985 | 18 m | Westinghouse |

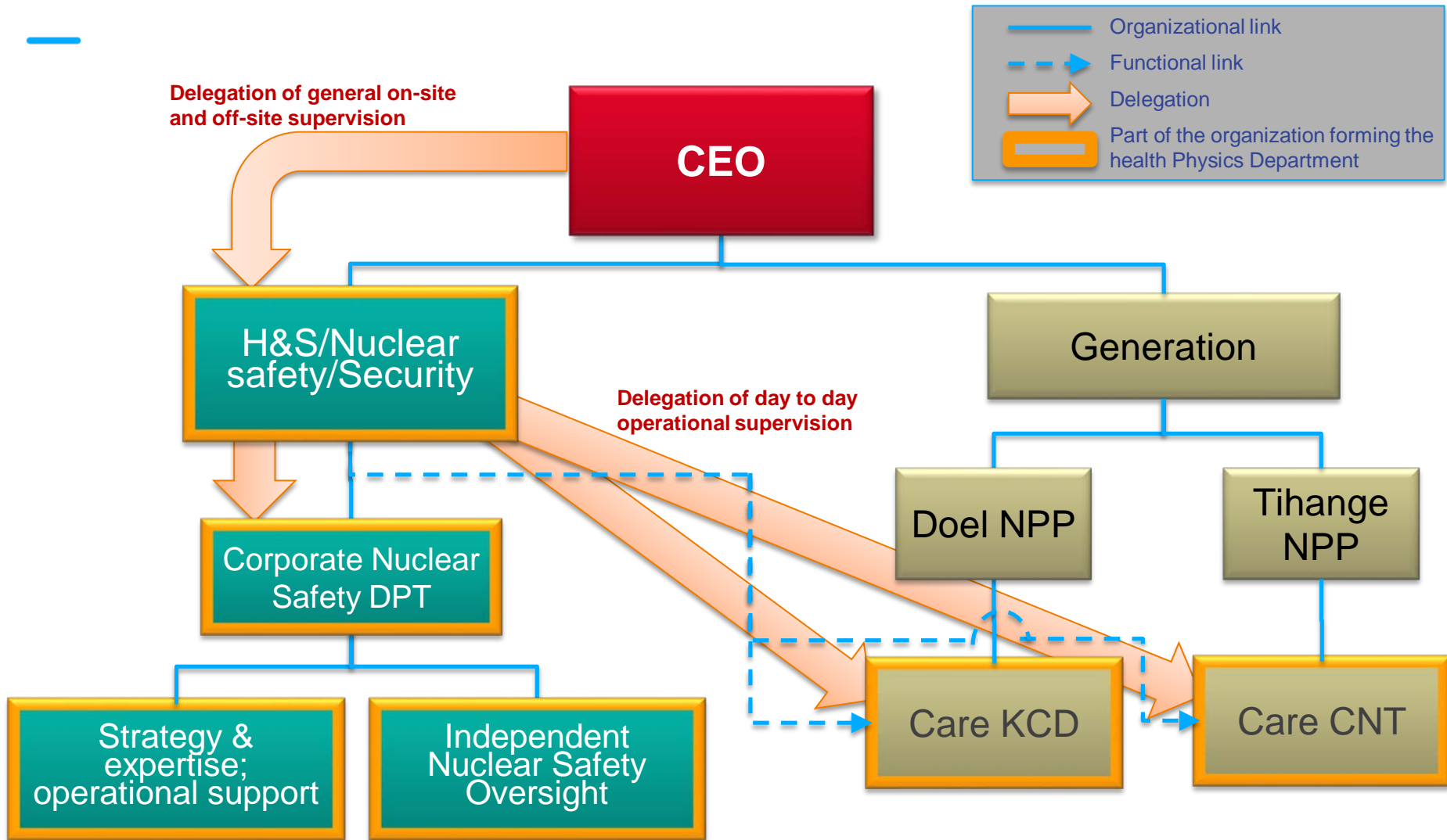
What is INSO ?

WANO PO&C's (CO.4) :

Independent oversight provides
the CNO and senior corporate leaders – up through the board of directors –
with an ongoing perspective of
Nuclear Safety performance at the nuclear stations and in the corporate
organisation compared to the industry



How is organized INSO @ ENGIE Electrabel ?



How is organized INSO @ ENGIE Electrabel ? (cont'd)

- Independent Corporate Nuclear Safety Departement started at Electrabel level in 2005.
- Focus on legal mission of the “Physical Control”: start of the development of the “NICO” work (inspections and controlling)
- Mission of the « Physical Control » : make sure that the necessary measures are taken in order to fulfill nuclear safety

Independent Nuclear Safety Oversight (INSO) at Electrabel =

- Local INSO : executed by the on site NS departments (CARE NS) +
- Corporate INSO: executed by the corporate NS department (ECNSD) +
- Independent NS Committee (INSC) : internal + external members

How is organized INSO @ ENGIE Electrabel ? (cont'd)

Independent Nuclear Safety Oversight (INSO) at EBL =

- Local INSO : executed by on site NS departement (CARE NS) +
- Corporate INSO : executed by ECNSD +
- Independent NS Committee (INSC) : internal + external members



Corporate INSO : executed by ECNSD, via

1. Corporate “resident” INSO’ers at KCD, CNT and Corp
(follow-up daily operations + challenge local INSO) +
2. INSO on projects (especially those managed at corporate level) +
3. Corporate INSO reviews (all aspects of nuclear safety)



Corporate INSO advices (defining)

- The **INSO advices** can be:
 - Good Practices (**GP**);
 - Concerns (**C**);
 - Areas For Improvement (**AFI**);
 - Recommendations (**R**);
 - Suggestions (**S**);
- These are delivered by INSO **through** their performed tasks/processes :
 - Review reports;
 - Hold & witness points for INSO/CP of projects;
 - Quarterly nuclear safety report (QNSR);
 - Annual nuclear safety report (ANSR);
 - Position Papers ECNSD and HPC
 - ...

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EX 1 : Respiratory Protection



Example 1 : Respiratory Protection (1)

- In 2012, comparison between procedures for interventions in Reactor Buildings.
 - ✓ Observation : thresholds of contamination and respiratory protections are different at Doel and Tihange
- Objectives of the review :
 - ✓ Verify the concentrations thresholds and understand their origin;
 - ✓ Verify the associated individual respiratory protection;
 - ✓ Provide governance;
 - ✓ Analyze the possibility to harmonize the practices on both sites

Example 1 : Respiratory Protection (2)

- Practices observed in 2012
- 3 groups of radionuclides : iodine, aerosols, noble gases.
- Thresholds used at Tihange :
 - ✓ $< 2 \text{ DAC} \rightarrow$ No specific protection.
 - ✓ $2 \text{ DAC} < \text{concentration} < 6 \text{ DAC} \rightarrow$ respiratory protection advised.
 - ✓ $> 6 \text{ DAC} \rightarrow$ respiratory protection mandatory.
 - ✓ Reference nuclides : I-131, Sr-90/Ce-144, Xe-133.
- Thresholds used at Doel :
 - ✓ Not based on DAC values but on ICRP 2 recommendations
 - ✓ These thresholds are more conservative than the DAC values, except for noble gases
 - ✓ Collected information doesn't allow to understand the threshold for all radionuclide categories (aerosols)
 - ✓ Reference nuclides : I-131, Cs-137, Xe-133
- → Request submitted to the ISOE forum on 25 Apr 2013

Example 1 : Respiratory Protection (3)

Aerosols / Iodine

| Bq/m ³ | Borssele | Nuclear (Spain) | Beznau | Leibstadt | Ringhals | KCD | CNT |
|--|----------|--------------------|--------|-----------|----------|-----|-----|
| Reference Nuclide | xxx | xxx | xxx | xxx | xxx | xxx | xxx |
| No protection | xxx | xxx | xxx | xxx | xxx | xxx | xxx |
| Mask P3 | xxx | xxx | xxx | xxx | xxx | xxx | xxx |
| Semi-autonomous protection / or full-face mask P3+ extra overall | xxx | xxx | xxx | xxx | xxx | xxx | xxx |
| Independent breathing system | xxx | xxx | xxx | xxx | xxx | xxx | xxx |

Utilities only

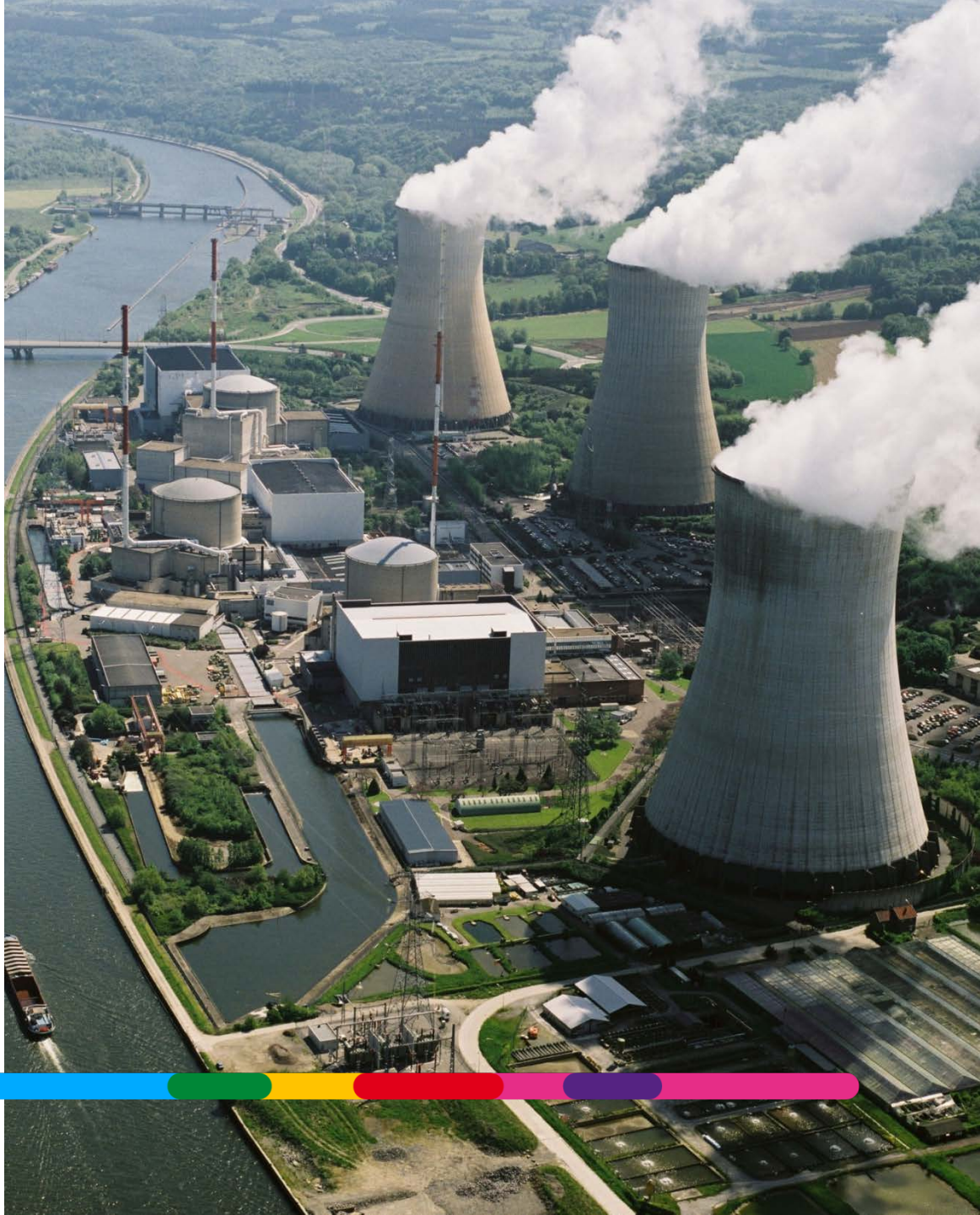
Example 1 : Respiratory Protection (4)

Major conclusions of the review:

- Significant differences between thresholds used at Doel and at Tihange (in procedures and to a lesser extent in practice).
- Conservative thresholds used at KCD, standard thresholds used at CNT, but no clear instruction between 2 and 6 DAC.
- Also important differences between other European operators.
- Some Areas for Improvement (AFI) :
 - **AFI 1** : The table of the DAC values mentioned in the Tihange procedure is not fully correct → suggestion
 - **AFI 2** : It was difficult to retrieve the origin of the thresholds. RP managers on both sites do not know the origin of the threshold → suggestion
 - **AFI 5** : No threshold for independent breathing system is defined at Tihange → recommendation

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EX 2 : Alarm Thresholds for EEPD's



Example 2 : Alarm Thresholds for EEPD's (1)

- Current situation for the Emergency Electronic Personal Dosimeters (EEPDP's)

- Intervention Dosimeters

- Doel (intervention & fire fighting)

- Dose alarm @ 10 mSv
- Dose rate alarm @ 30 mSv/h

- Tihange (first interveners)

- Dose alarm @ 1 mSv
- Dose rate alarm @ 1 mSv/h

- Dosimeters for Radiological emergency

- Doel

- Dose alarm @ 200 mSv (w.r.t regulatory threshold)
- Dose rate alarm 750 mSv/h (avoid spurious alarms)

- Tihange

- Dose alarm @ 50 mSv (w.r.t regulatory threshold)

- Differences no longer acceptable with regards to get support from the unaffected site in case of serious accident (post-Fukushima insight)

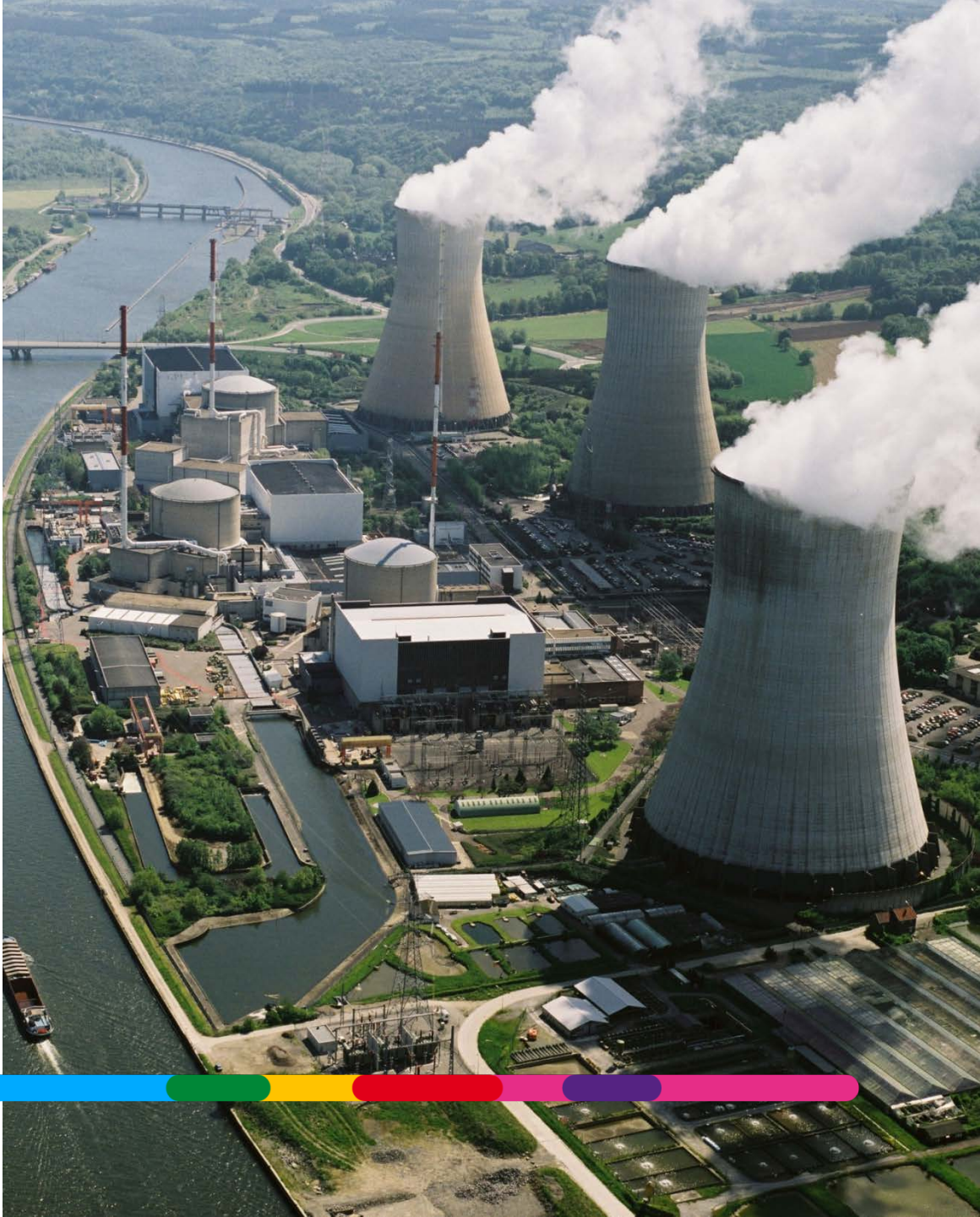
Example 2 : Alarm Thresholds for EEPD's (2)

- → Request submitted to the ISOE forum on 28 Nov 2013
- Results from the request :
 - Utilities having answered : EdF, Cernavoda, Sizewell B UK, Forsmark, Temelin, Dukovany
 - Different approaches observed
 - Thresholds are defined according to the activity, rather than to the worker category
 - Some approaches strongly ALARA oriented
 - However no (or few) information w.r.t the rationale for determining the dose thresholds
- → A common position will be determined in 2016, taking into account scenarii analysis developed by the safety authorities for the public interveners (police, fire fighters, etc.)



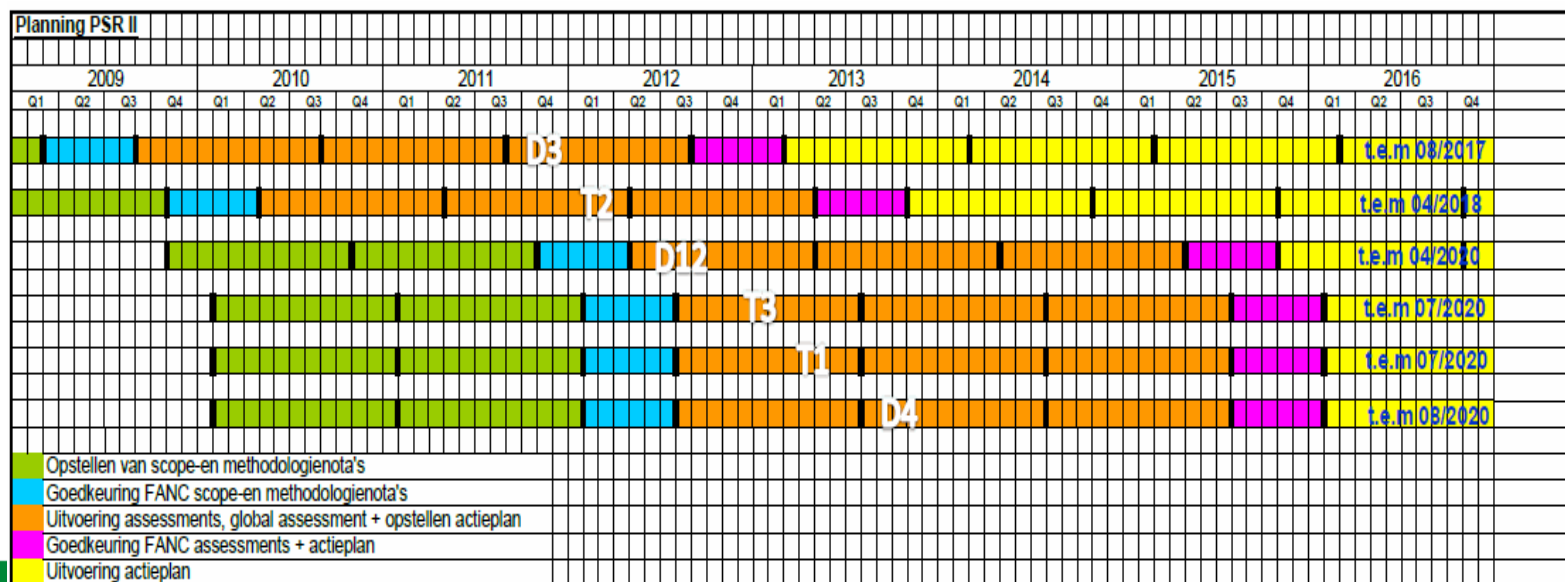
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EX 3 : 10y assessment of RP results



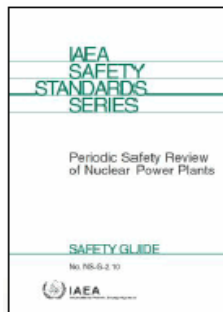
Example 3 : 10 y assessment of RP results (1)

- 10 yearly Periodic Safety Review
- As required by law, every nuclear installation has to perform an exhaustive nuclear safety assessment every 10 years
- The PSR verifies whether the nuclear safety level of the plant still meets the updated international safety standards and the current practices, and assesses whether the plant can be operated safely until the next PSR
- PSR process sticks to the anniversary dates written in the « phase out law »

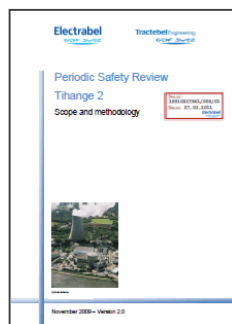


Example 3 : 10 y assessment of RP results (2)

IAEA
NS-G-
2.10



Scope &
Methodology



Reference
Framework



List of items in Periodic Safety Review (IAEA NS-G 2.10 [2.1])

| Subject area | Safety Factor | |
|--|---------------|---|
| | | |
| Plant | 1 | Plant design |
| | 2 | Actual condition of SSCs |
| | 3 | Equipment Qualification |
| | 4 | Ageing |
| Safety analysis | 5 | Deterministic Safety Analysis |
| | 6 | Probabilistic Safety Analysis |
| | 7 | Hazard Analysis |
| Performance and feedback of experience | 8 | Safety Performance |
| | 9 | Use of experience from other plants and research findings |
| Management | 10 | Organisation and administration |
| | 11 | Procedures |
| | 12 | Human factors |
| | 13 | Emergency planning |
| Environment | 14 | Radiological impact on the environment |
| | | Global Assessment |

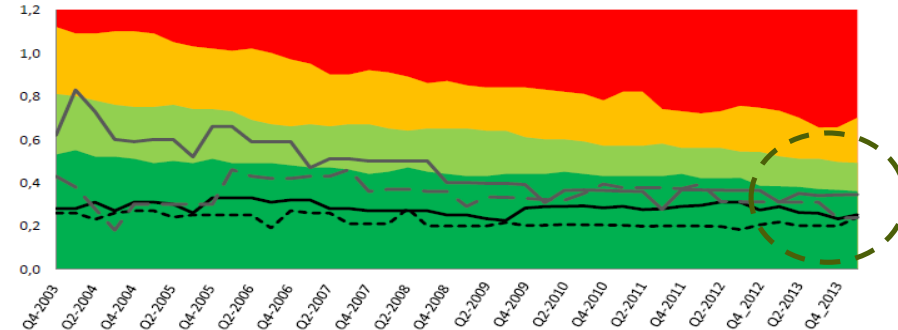
Example 3 : 10 y assessment of RP results (4)

- RP results mainly assessed in the Safety Factor 8
- Aspects of RP also assessed in other Safety Factors (ex : SF11 for the procedures)
- Extensive use of the ISOE data and MADRAS functionality to perform assessment
- RP results analysed :
 - ✓ Annual collective dose
 - ✓ Annual collective dose per TWh
 - ✓ Dose rate indicators
 - ✓ Tasks doses
 - ✓ Doses distribution

Example 3 : 10 y assessment of RP results (5)

Collective radiation exposure

- Good results confirmed through both the WANO CRE indicator and ISOE data
- More and more difficult to remain in the WANO best quartile



| Unit | Country | Average annual collective dose (2005-2012) | Average dose index (2005-2012) |
|------------|---------------|--|--------------------------------|
| Doel4 | Belgium | 204.24 H.mSv | 6.53 µSv/h |
| Tihange3 | Belgium | 328.66 H.mSv | 5.49 µSv/h |
| Ringhals3 | Sweden | 351.56 H.mSv | 13.03 µSv/h |
| Summer1 | United States | 393.33 H.mSv | 8.70 µSv/h |
| Almaraz2 | Spain | 393.41 H.mSv | 8.57 µSv/h |
| Tihange1 | Belgium | 394.41 H.mSv | 7.79 µSv/h |
| Almaraz1 | Spain | 409.31 H.mSv | 8.38 µSv/h |
| Asco2 | Spain | 425.82 H.mSv | 8.46 µSv/h |
| Harris1 | United States | 427.95 H.mSv | 5.44 µSv/h |
| Asco1 | Spain | 439.00 H.mSv | 8.48 µSv/h |
| Hanbit1 | South Korea | 526.59 H.mSv | 23.21 µSv/h |
| Vandellos2 | Spain | 596.30 H.mSv | 7.05 µSv/h |
| Kori4 | South Korea | 636.49 H.mSv | 17.28 µSv/h |
| Hanbit2 | South Korea | 706.57 H.mSv | 19.87 µSv/h |
| Ringhals4 | Sweden | 755.43 H.mSv | 21.62 µSv/h |
| Kori3 | South Korea | 908.09 H.mSv | 28.41 µSv/h |

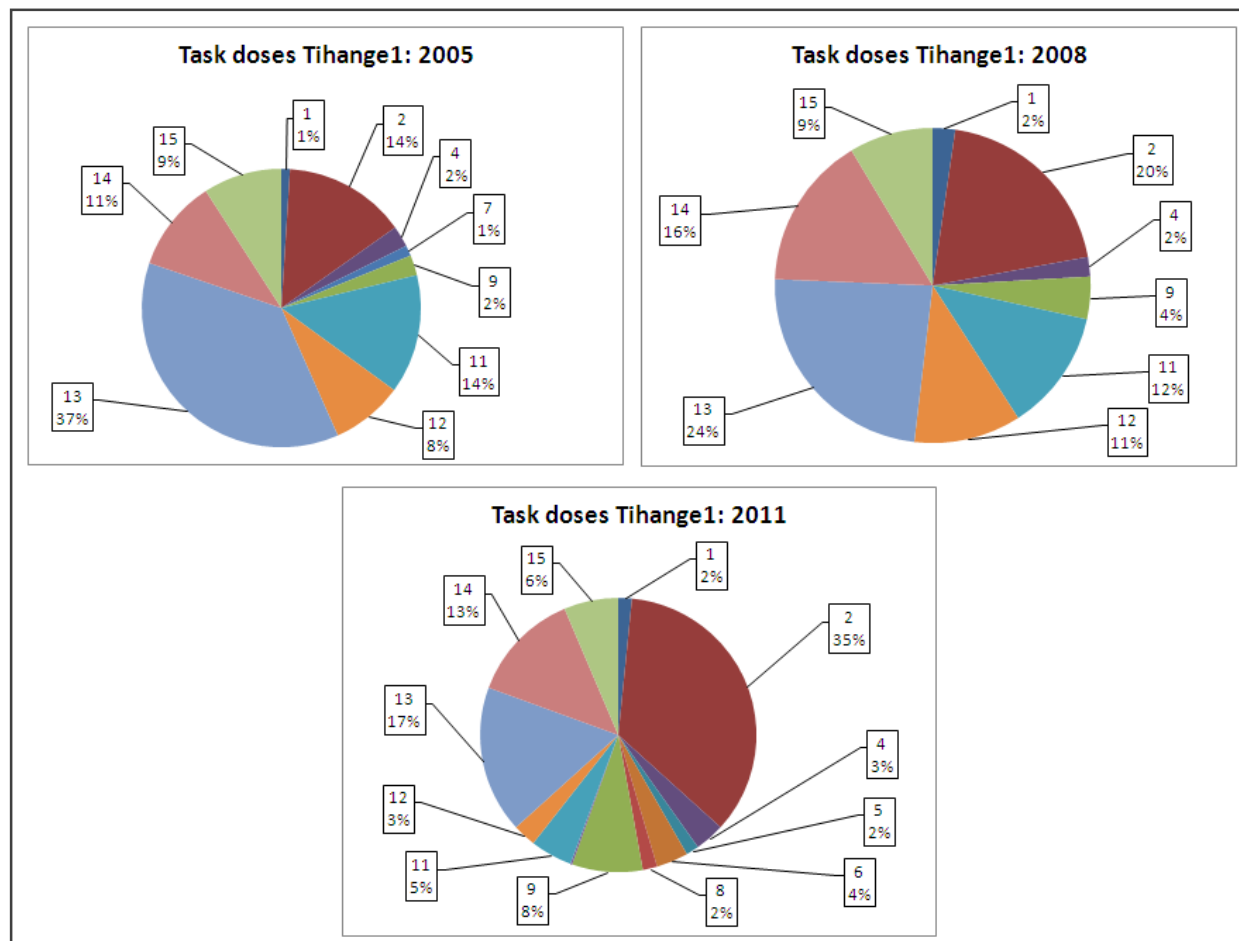
Sister Unit Group: “W32 – 3 Loops reactors from the 2nd generation of Westinghouse”.

Electrabel Corporate Nuclear Safety Department
Periodic Safety Review II D12, D4, T1 & T3

Example 3 : 10 y assessment of RP results (6)

Dose per task

Sometimes, decreasing trend for some tasks (eg. Fuel un/loading) is counterbalanced by increasing trend from other tasks (eg. Routine inspections), making the global CRE trend almost constant



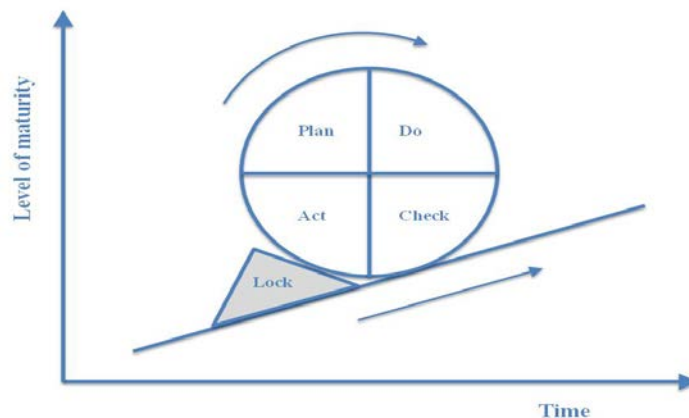
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Conclusions and perspectives



Conclusions and perspectives

- INSO at ENGIE Electrabel is well anchored and further development & implementation is expected at the level of the ENGIE Group
 - ✓ ENGIE service companies will indirectly benefit from the insights gained from ISOE : ENDEL, CERAP, INEO, etc.
- Participation to ISOE is a tool to pursue our policy of continuous improvement of nuclear safety
 - ✓ ISOE data (10 y PSR)
 - ✓ ISOE forum (reviews)
 - ✓ ISOE workgroups (EG-SAM)
 - ✓ ISOE networking (today 😊)
- Recent request : identification of alpha risk for the NPP revision (considered during RPM meeting of 31 may)



Thank you for your attention

Questions ?

