



EDF INDUSTRIAL PROGRAM OF MAINTENANCE: IMPACT ON THE COLLECTIVE DOSE AND SUBSEQUENT ALARA ACTIONS

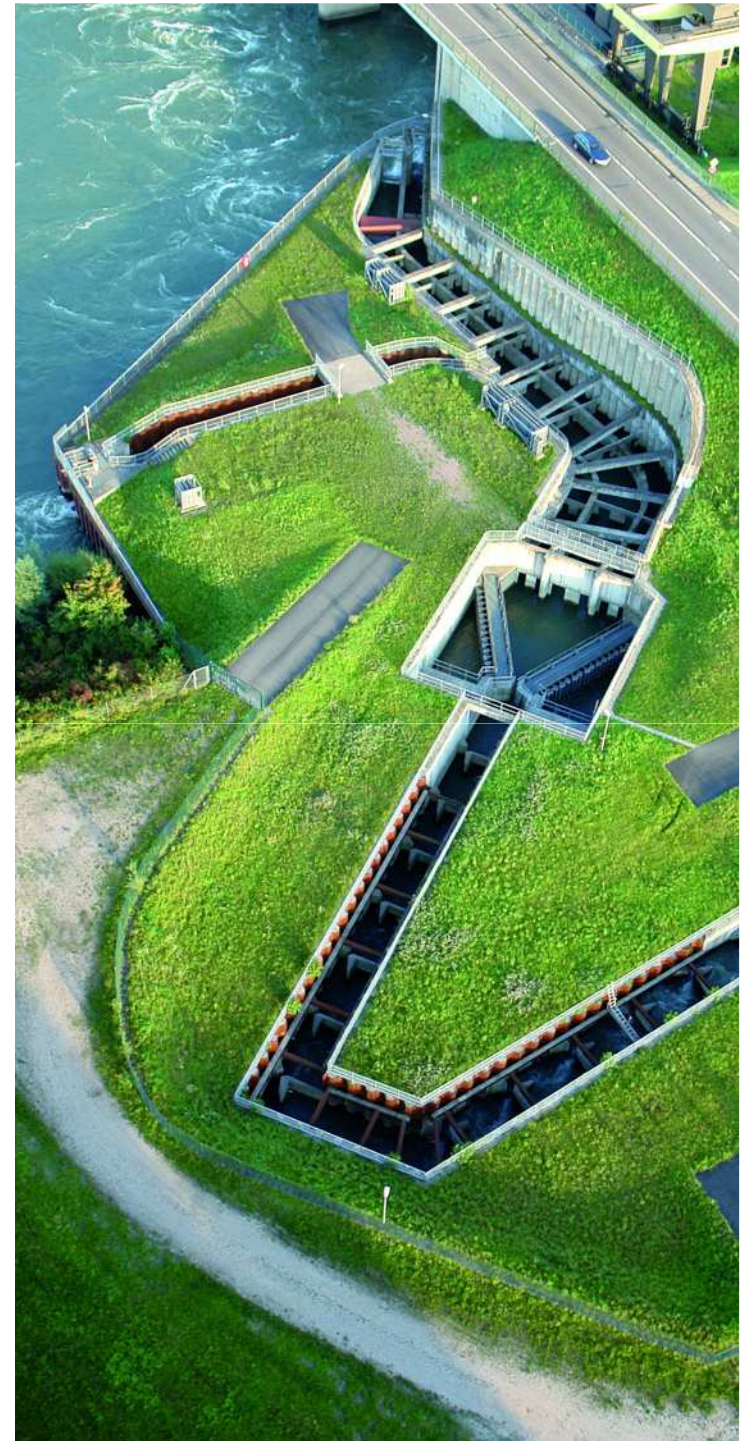
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ISOE Symposium – Bern
9 April 2014



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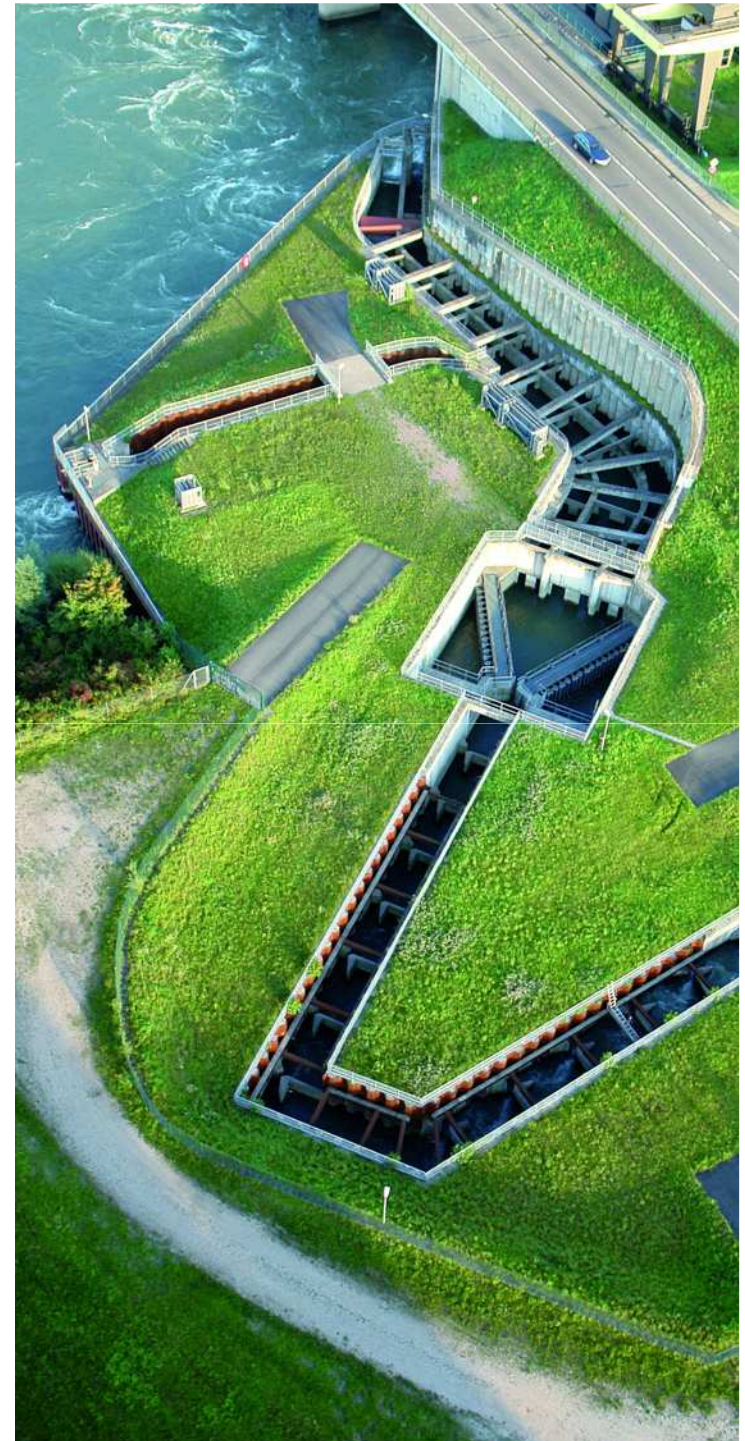


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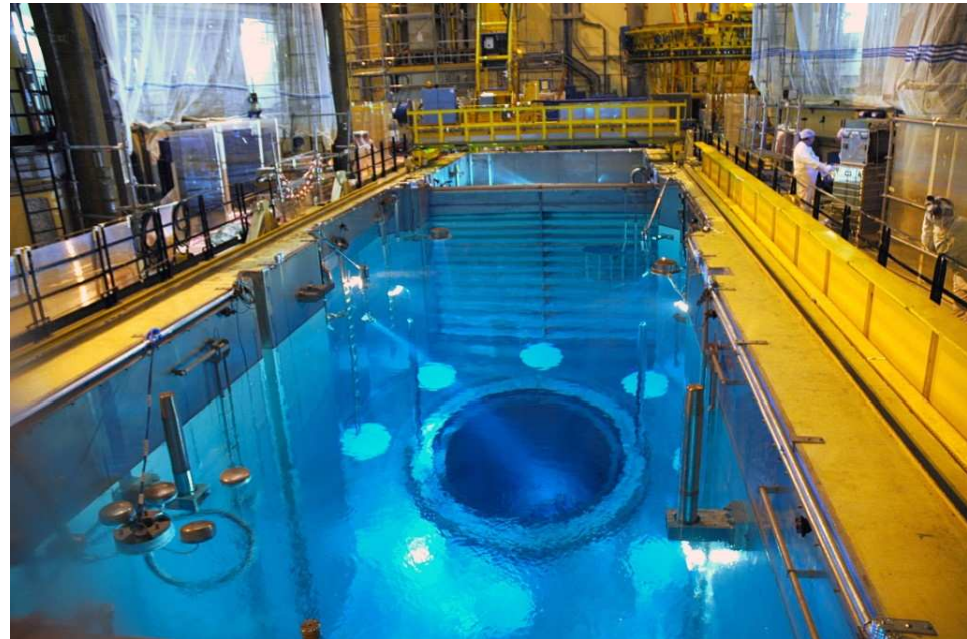


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EDF industrial program of maintenance and modifications

- The main goals of the program are the following:
 - Implement the technical conditions to **operate the French reactors over 40 years**
 - Integrate the consequences of the **Fukushima accident**
- The achievement of these goals results in the increase of modifications, renovations and maintenance programs both in and outside the RCA



More activities in RCA



Increase of doses

Significant dosing activities of the program

- **Activities with a significant impact on doses – collective dose associated to dosing activities multiplied by a factor of 1.6 in 2020 compared to 2012**

- **Modifications**

- SGR 1300 (up to 3 per year) + primary circuit elbow replacements: 800 person.mSv + 200 person.mSv per A elbow,
- Other modifications: about 300 man.mSv during 3rd 10-year outages for 1300 MWe units,
- Etc.



Significant dosing activities of the program

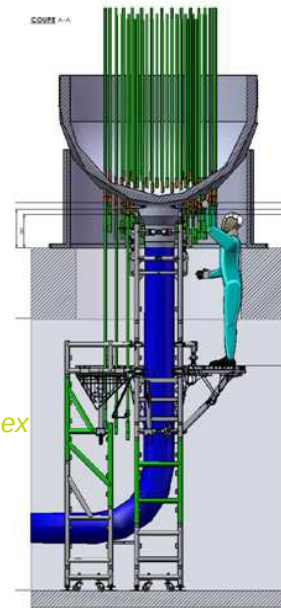
■ Activities with a significant impact on doses – **collective dose associated to dosing activities multiplied by a factor of 1.6 in 2020 compared to 2012**

□ Maintenance :

- Replacement of pressurizer heaters: 70 person.mSv per activity (up to 13 per year),
- Replacement of RCC guide tubes: between 25 and 50 person.mSv per activity,
- Replacement of control rod drive mechanisms: between 100 and 190 person.mSv per activity for 40 mechanisms,
- Replacement of reactor coolant pump hydraulic units: 25 person.mSv par unit,
- Replacement of CVCS heat exchangers: between 60 and 100 person.mSv per activity,
- Etc.



Photo by Comex Nucléaire



Picture by Comex Nucléaire

Significant dosing activities of the program

- **Activities with a significant impact on doses – collective dose associated to dosing activities multiplied by a factor of 1.6 in 2020 compared to 2012**
 - **Post-Fukushima modifications:** about 10 person.Sv between 2015 and 2020,
 - **New hydrostatic tests required by French regulation,** including CVCS and RHRS: hydrostatic tests to be performed on each of the 58 French reactors between 2015 and 2020.

- **Global increase of work volume for activities performed in RCA:**
 - **Valve activities**
 - Work volume multiplied **until a factor of 1.6** by 2022 (dose impact ~10 to 15% of the collective dose).
 - **Logistics**
 - Work volume multiplied **until a factor of 1.5** by 2022 (dose impact ~15 to 20% of the collective dose).
 - **Inspections/controls**
 - Work volume multiplied **until a factor of 1.4** by 2022 (dose impact ~10% of the collective dose).

Evolution of the collective dose

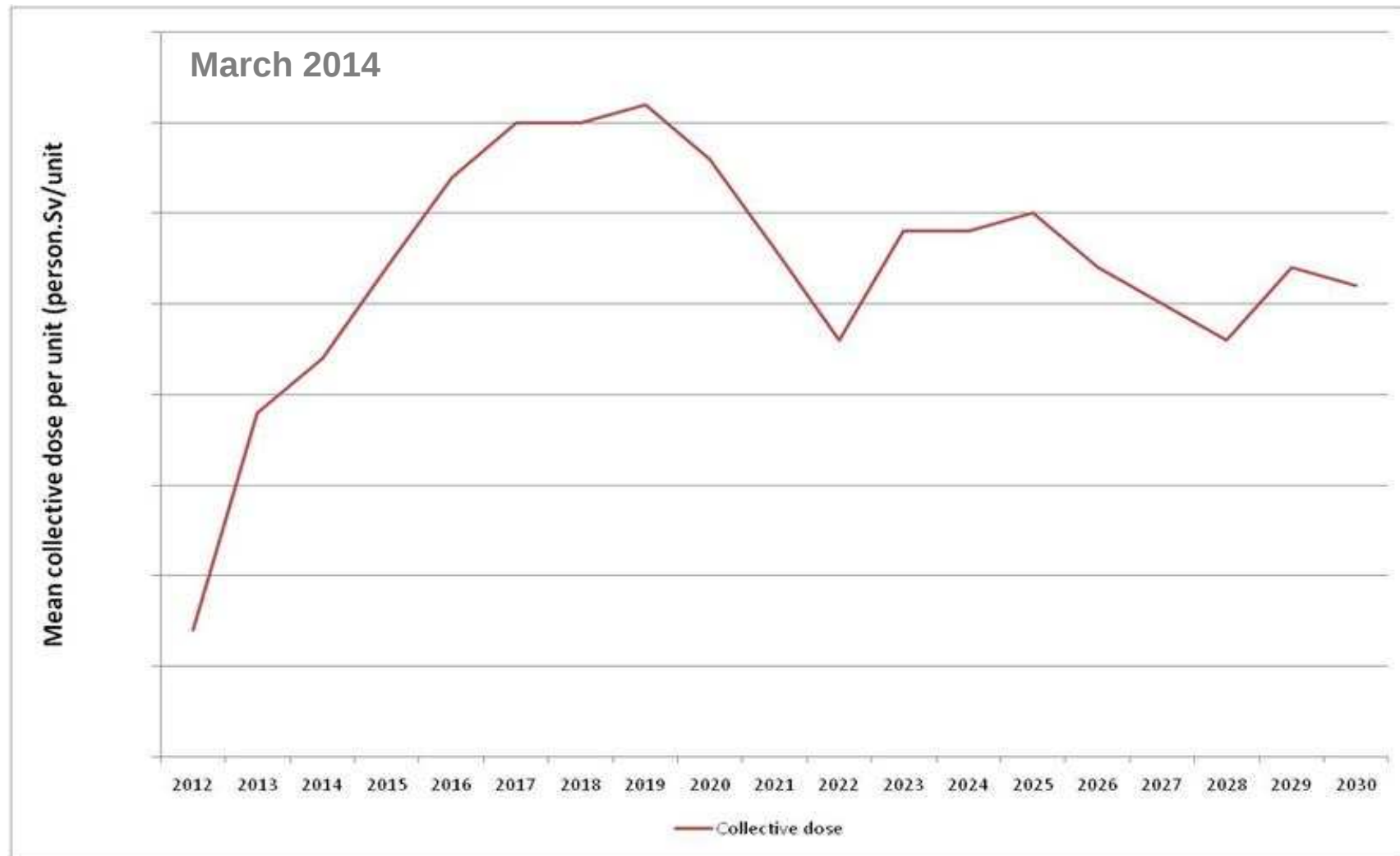
■ 1st approach

- A specific matrix allows to connect the evolution of costs and collective dose depending on the kind of activities (for instance, activities on the reactor, logistics, etc.): costs and doses were connected based on 2012 real data,
- The ratio between work volume in and outside the RCA is considered to be constant.

■ 2nd approach

- Based on 2012 real data for the main activity families (valves activities, inspections/NDT, logistics, etc.), dose and work volume are considered to increase in the same way. The ratio between work volume in and outside the RCA is considered to be constant,
- Knowing the specific collective dose, the main dosing activities are added to the global evolution.

Evolution of the collective dose – 1st approach



- Significant increase until 2020 (+30% compared to 2012) then progressive decrease between 2020 and 2030.

Management of collective dose

Generic ALARA actions

- 3 main technical ALARA actions applicable on the entire fleet may allow to save until 16% of the collective dose

- Decontamination of the most polluted circuits to homogenize the source term between reactors (impact: ~1% of the fleet collective dose saved)

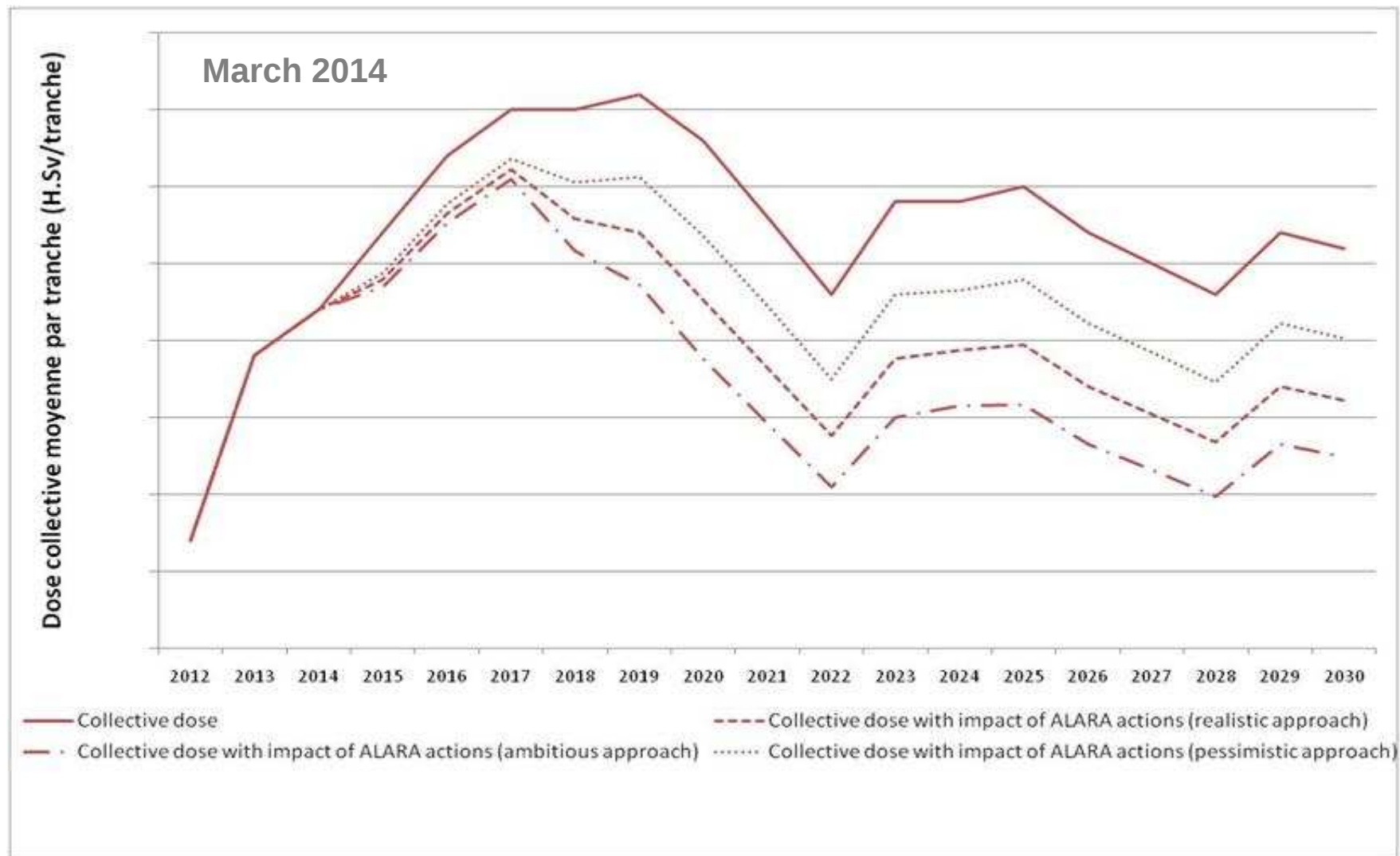


- Development of the CADOR software to optimize the use of biological shielding during outages (impact: ~1 to 2% of the fleet collective dose saved)

- Remote Monitoring System (RMS) to supervise activities (impact depending on the hypothesis: ~5 to 13% of the fleet collective dose saved)



Impact of ALARA action on the evolution of collective dose



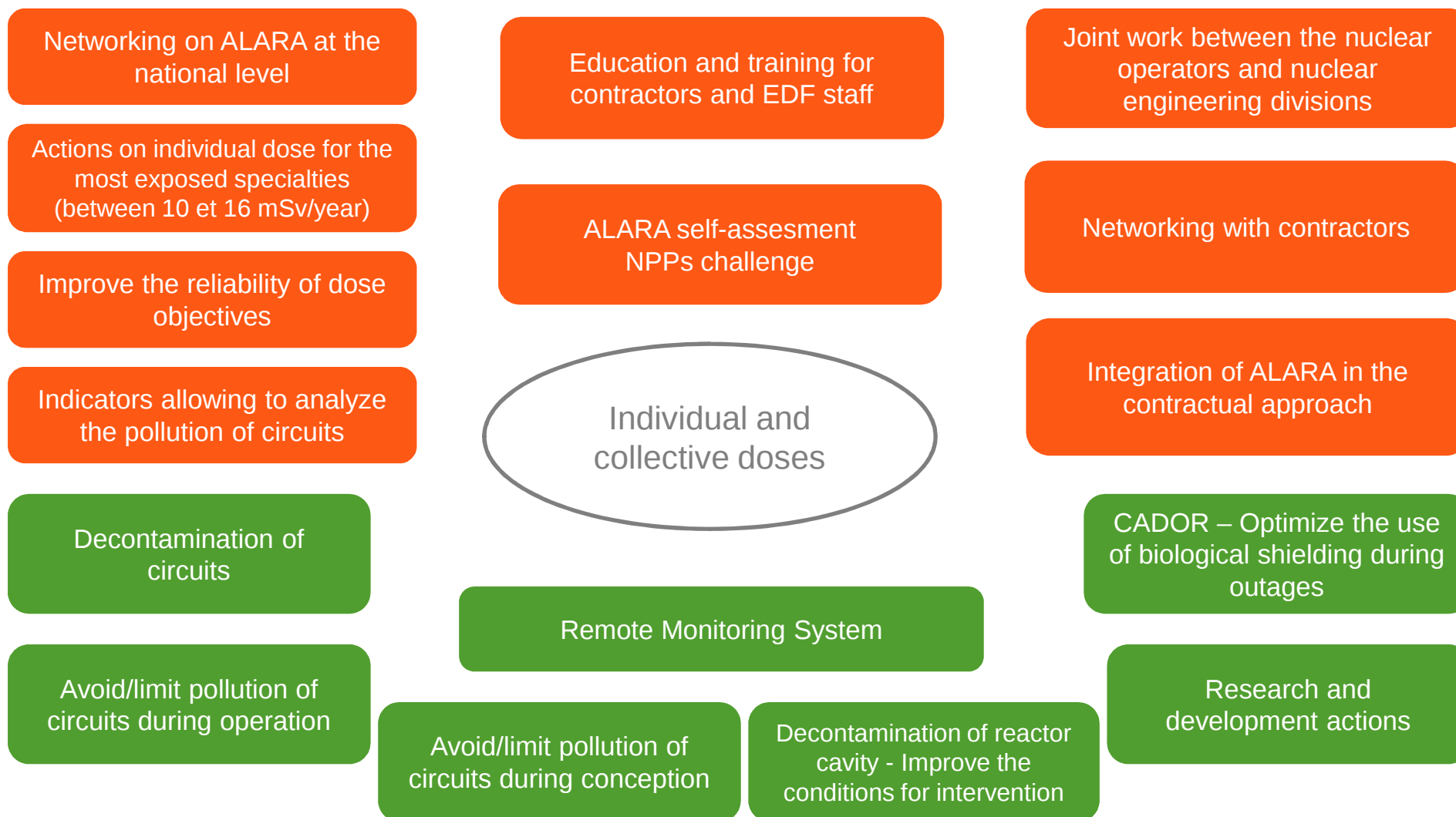
- Possible dose savings until 16% of the collective dose by implementing the main technical ALARA levels.

Conclusions

- The EDF industrial program of maintenance and modifications will have a **significant impact** on collective doses.

- **Since already 2 years**, EDF evaluates the impact on doses and perform actions to manage the forecasted increase of doses:
 - **Managerial and networking actions**, which cannot be quantified in terms of dose savings but which allow challenging NPPs, enhance good practice exchange, etc.,
 - **Technical actions** inducing improvement on source term and/or exposed work volume and thus allowing saving on doses,
 - **Specific actions** in collaboration with contractors employing staff with **high individual doses**.

National and local managerial actions



THANK YOU