

Dose per RCA hour – a useful RP indicator ?

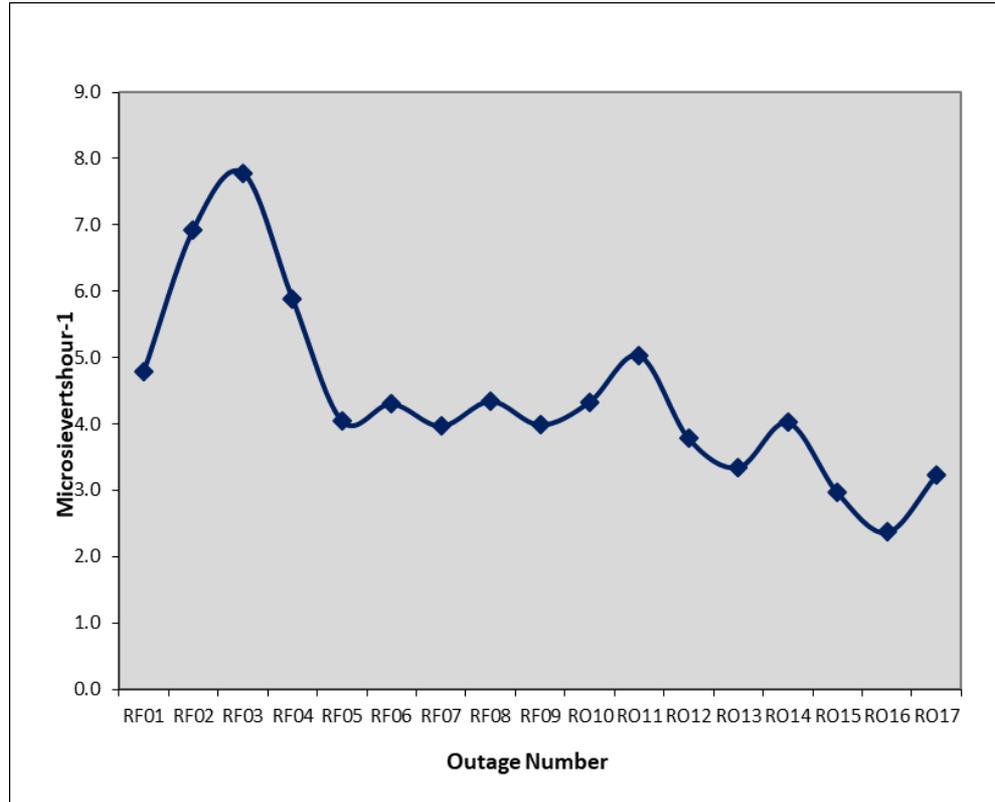
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Introduction

- Indicators are widely used within the nuclear industry in order to measure the performance. With comparisons within the nuclear fleet, they are meant to reflect the effectiveness of the respective organisations.
- Around the world, the dose per RCA hour during outages is highly considered
- In Sizewell B, this indicator has been measured and trended since start-up and a generally decreasing trend has been noticed in recent outages.
- Does dose per RCA hour actually tell us anything about the plant's dose management performance?

Sizewell B Trend of Dose per RCA-Hour by Outage

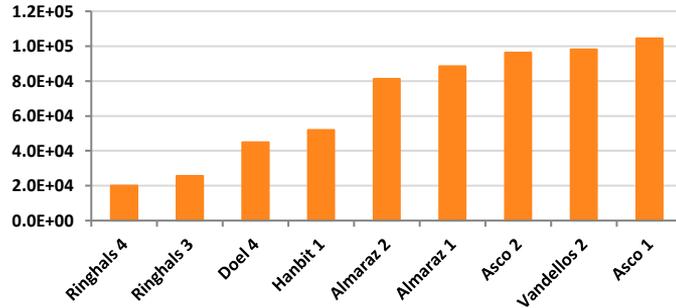


Indicator analyses

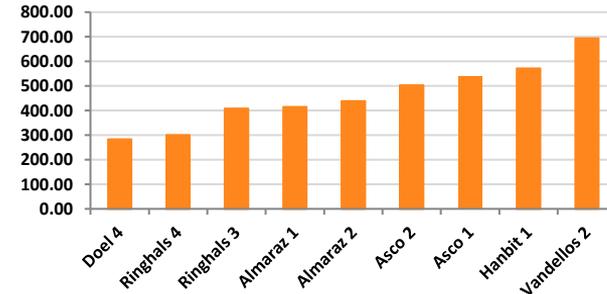
- To better understand the basis of the dose per RCA hour for a plant, it is necessary to quantify the “source term” and the RCA hours worked.
- As a surrogate for the NPP “source term” we calculated an average RCS index, using the hot and cold leg dose rates recorded in the ISOE1 annual questionnaires .
- We then investigated whether there was any correlation between these indicators and the actual collective radiation exposure.
- Unfortunately we could not use Sizewell for our study since their was insufficient data for reactors in Sizewell’s sister group (W42).

W32 NPP comparison

Mean RCA Hours 2013/2019 (man-hours)

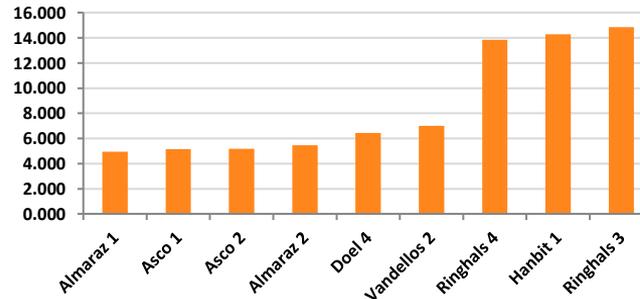


Mean Collective Radiation Exposure 2013-2019 (man.mSv)



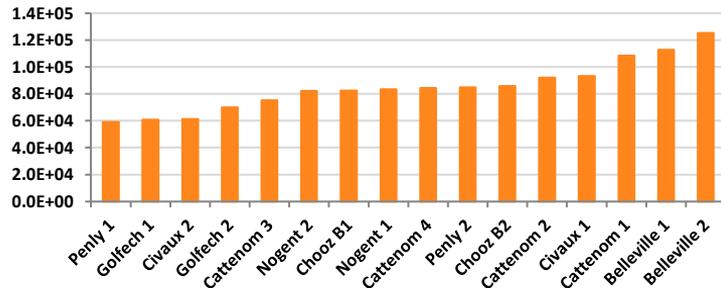
These graphs indicate that, on average, the Northern European plants at Ringhals and Doel have less RCA hours and perhaps unsurprisingly have lower doses – however the Dose per RCA hour is relatively high at Ringhals – so it would appear that dose/RCA-hour is not providing a good insight into the NPP's dose management. Instead dose/RCA hour reflects the very low number of RCA hours in Sweden in comparison to peer NPPs (which is cultural). The variance in RCA hours is much higher than for CRE.

Mean Dose/RCA Hour 2013-2019 ($\mu\text{Sv/h}$)

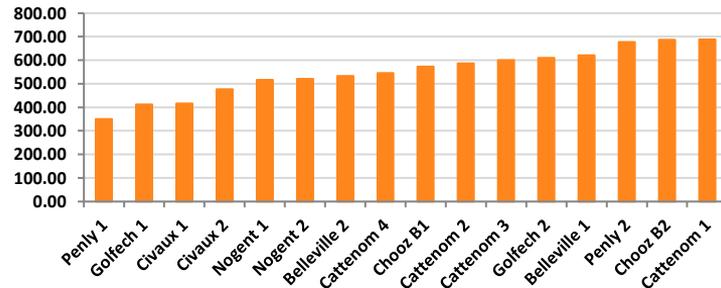


F42 French NPP comparison

Mean RCA Hours 2013/2020 (man.hours)

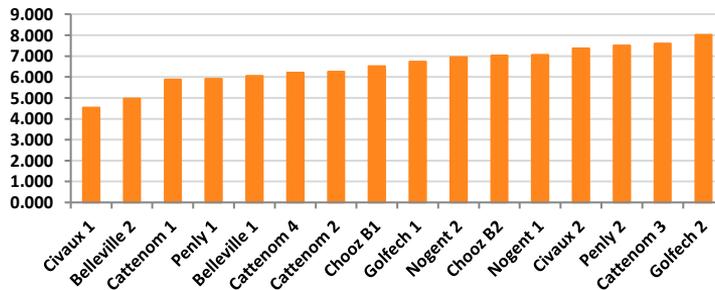


Mean Collective Radiation Exposure 2013-2020 (man.mSv)



There is a much lower less variance in RCA hours within the French NPP cohort reflecting the homogeneity of the work management culture. The variance in dose per RCA hour is probably due to the work scope, i.e. NPPs with higher dose/RCA hour have performed more higher doserate tasks.

Mean Dose/RCA Hour 2013-2020 (uSv/h)



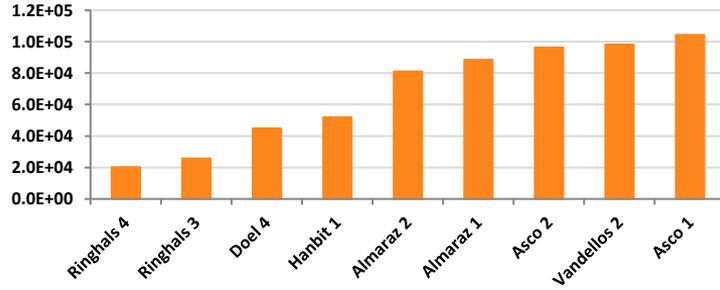
W32 NPP comparison: Actual vs Theoretical CRE

We calculated a theoretical CRE by multiplying average outage hours by average RCS index.

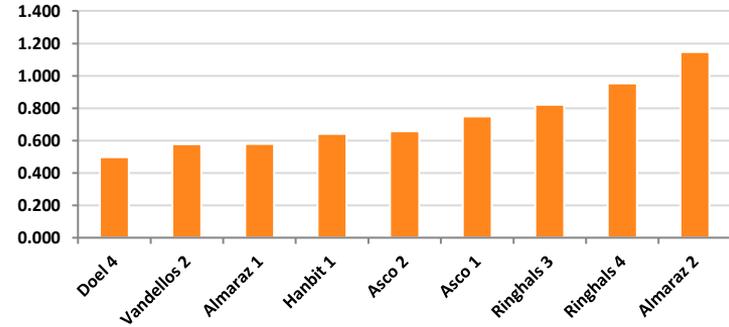
Thus comparing actual and theoretical CRE might help to identify differences in dose management effectiveness.

W32 NPP comparison: Actual vs Theoretical CRE

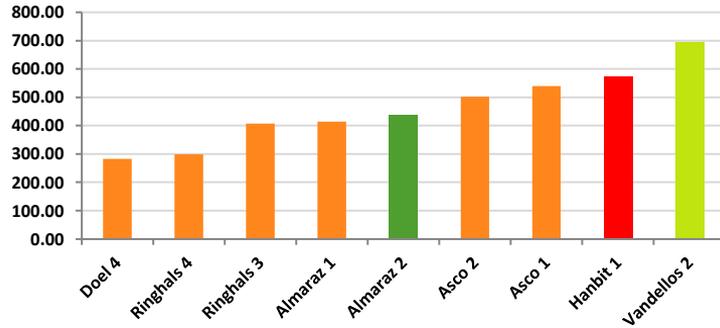
Mean RCA Hours 2013/2019 (man-hours)



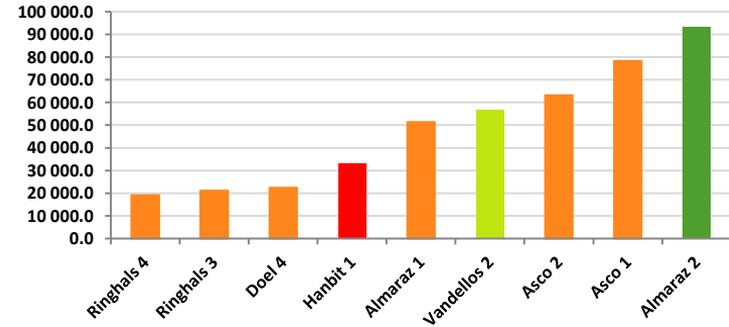
Mean RCS Index 2013-2019 (mSv/h)



Mean Collective Radiation Exposure 2013-2019 (man.mSv)

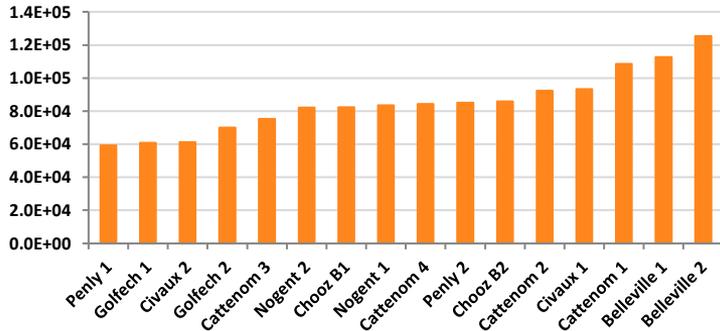


Theoretical Collective dose 2013-2019 (arbitrary units)

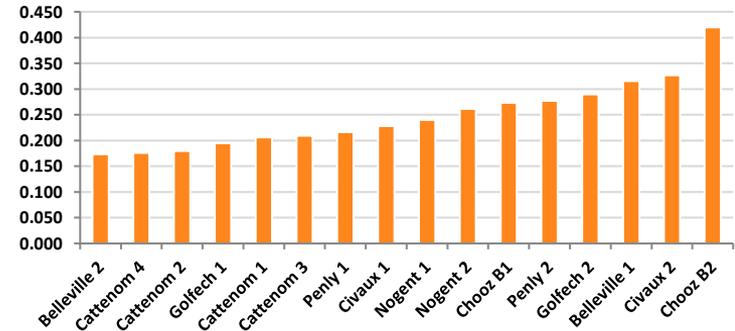


F42 French NPP comparison: Actual vs Theoretical CRE

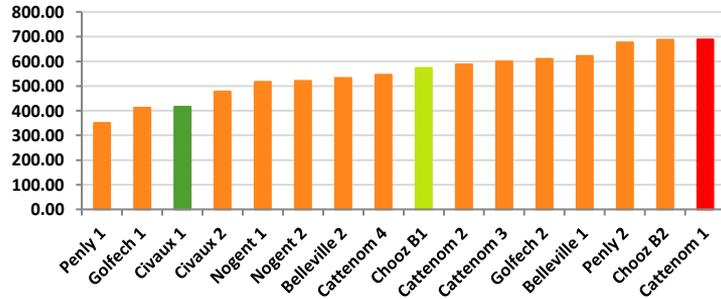
Mean RCA Hours 2013/2020 (man.hours)



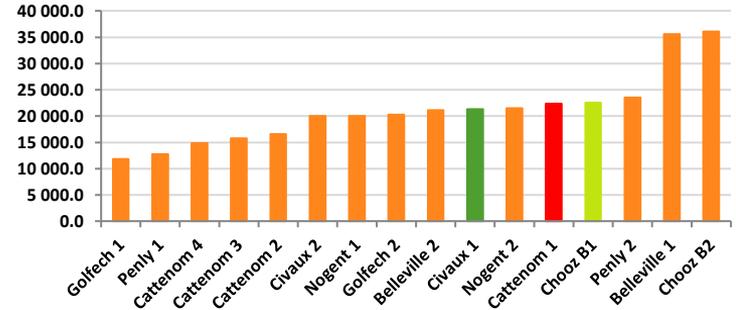
Mean RCS Index 2013-2020 (mSv/h)



Mean Collective Radiation Exposure 2013-2020 (man.mSv)



Theoretical Collective dose 2013-2020 (man.mSv)

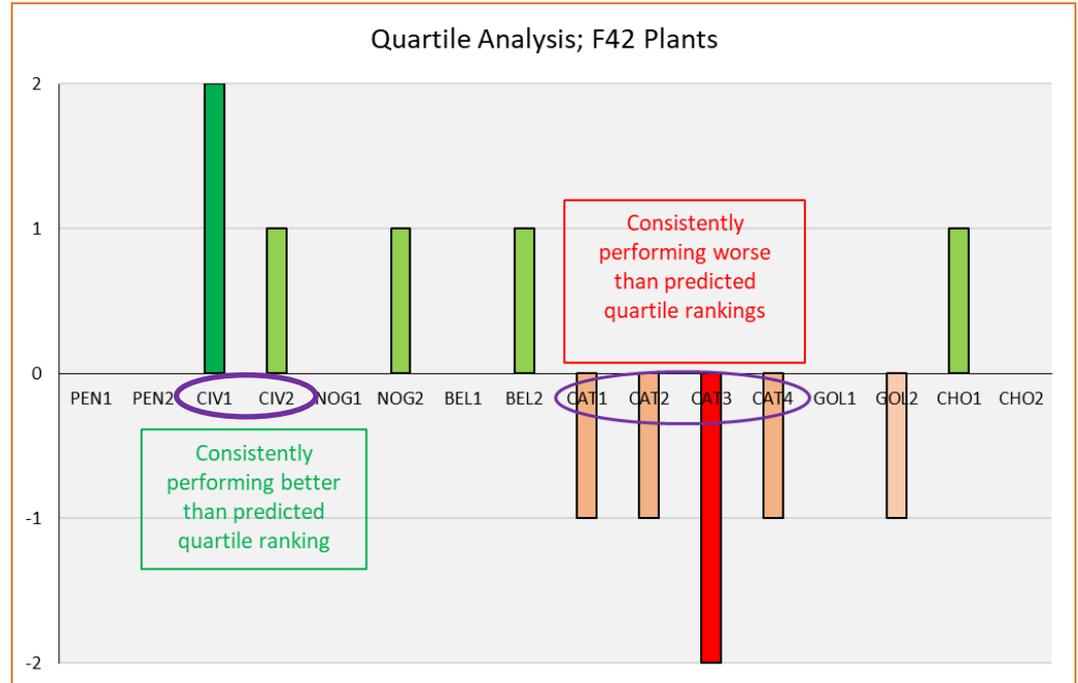


Conclusion 1

- This study verifies that dose management performance will depend upon the number of RCA-hours and the source term of the significant work sites (in terms of work-hours).
- We concluded that the RCS index may not be a reliable indicator of plant's source term so may distort the data and therefore any interpretation of results.
- In isolation, our analysis of the dose per RCA hour indicator provides little insight into an NPP's dose management performance. Evidently the plant with the lowest dose/RCA hour does not necessarily represent the best RP performance.

Further Analysis of French Data

- We then took the French data and compared each plant's predicted and actual quartile ranking.
- This comparison highlighted an apparent trend for two plants, with all reactor units either performing better than or worse than their predicted rankings.
- Of course these comparisons may not be valid but it would be interesting to know whether other RP programme indicators validate or contradict our findings.



Conclusion 2

- The study suggests that both the utility work management approach and national cultural characteristics will influence the number and nature of RCA hours, for example, work crew size, supervisory levels, the choice of activities carried out during outages etc.
- Therefore comparisons are likely to be most productive within NPPs with similar work cultures and work management practices.
- This study might serve as an example of how existing ISOE data can be better analysed for the benefit of the membership, whilst providing a new generation of RP professionals with insights about RP programme philosophies and effectiveness.

Thank You

