

ALMARAZ NPP: PAST, PRESENT AND FUTURE

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Introduction

The subject of current document is present the dose rates evolution in Almaraz Nuclear Power Plant from the years previous of steam generators change in both units to now, and the crucial importance of the design changes implanted from the ALARA point of view as well as the application of that principle to the proceedings and work performance.

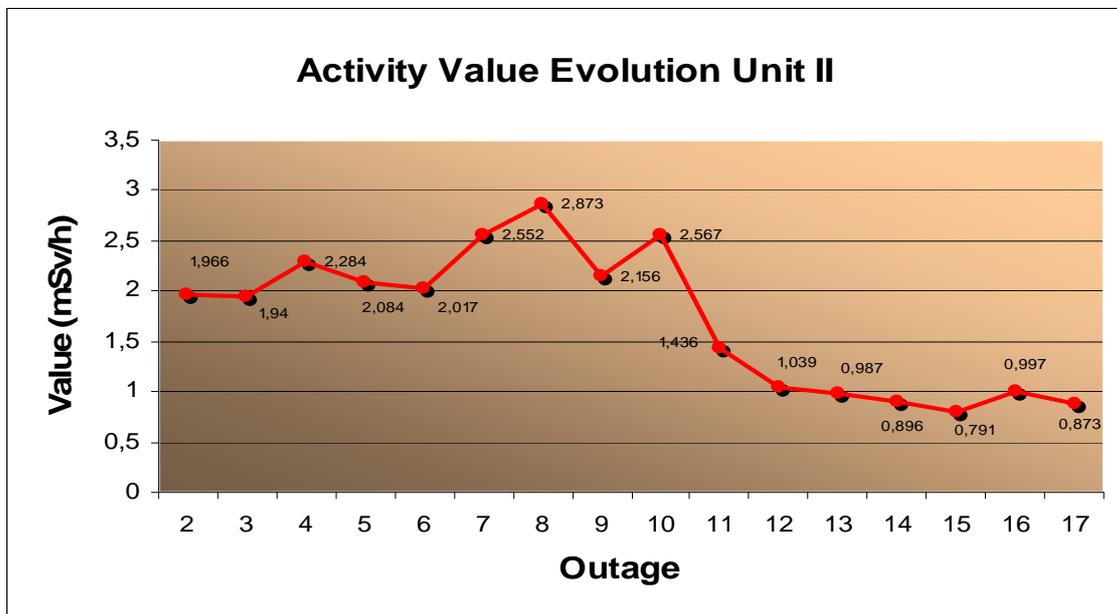
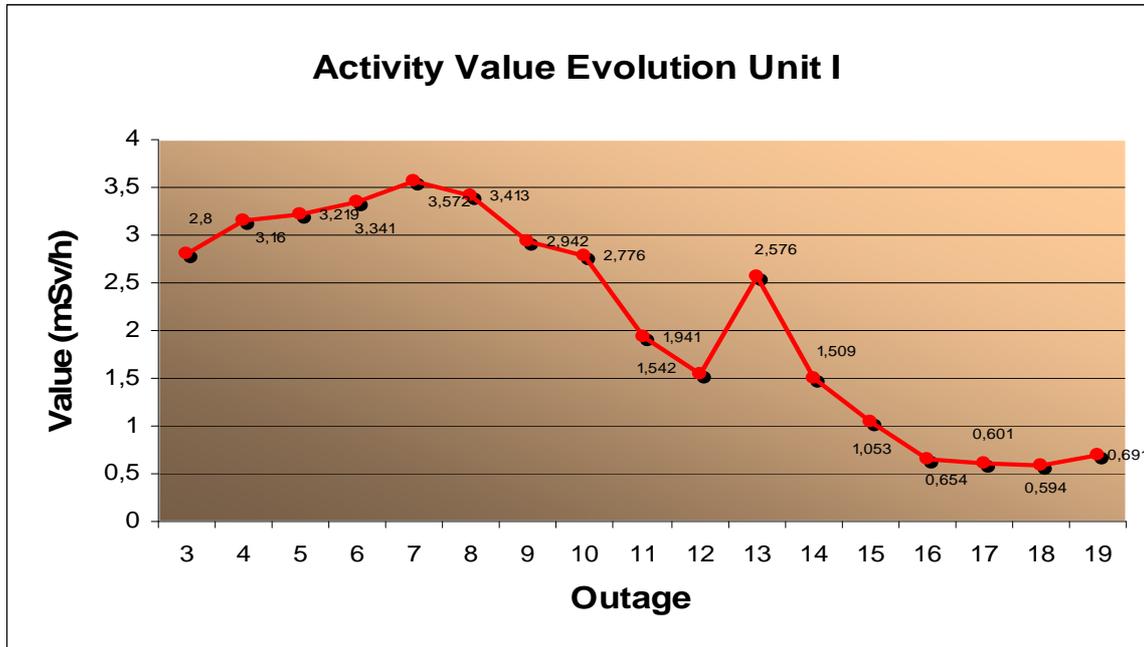
A little bit of history

Almaraz NPP is a so-called second generation PWR Westinghouse reactors. It consists of two units with 979 and 983 MWe, respectively, with security and auxiliary common system building. Unit I started up in commercial operation in 1981 and Unit II in 1983. Nowadays, it's immersed in a power uprating of 8% per reactor. It is located in Cáceres, in the southwest of Spain.



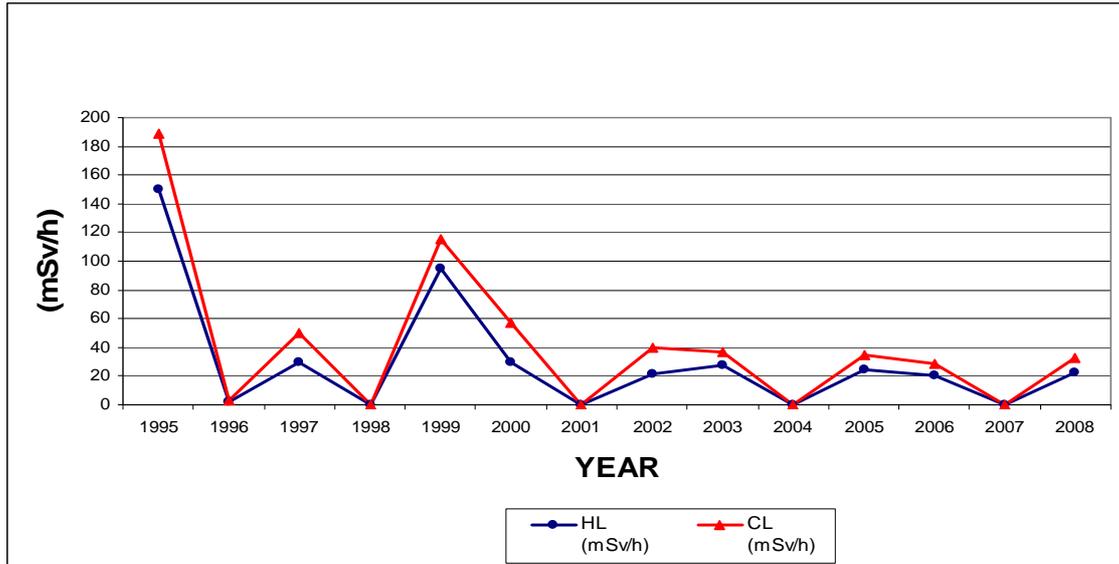
During the period between 1981 and 1996 the radiation levels, and therefore the collective dose and individual dose were higher than expected due the radiation levels produced by the design of the plant, emphasizing the dose rates in steam generators and valves. For that reason, during the years 1996 and 1997 the steam generators in both units were replaced. Furthermore, during that period a satellite valve replacing plan was implemented and finished and the reactor vessel head was replaced in both units.

From that moment, the radiation levels started to decrease, and there were very similar until 1999, where the dose rates during the outage of Unit I were increased remarkably due the secondary neutron start up source break, contaminating the reactor cooling system (RCS) and auxiliary systems with Sb-122 and Sb-124. Next figure shows the activity value evolution (this value is estimated from the “in contact” radiation levels in steam generators) in both units:

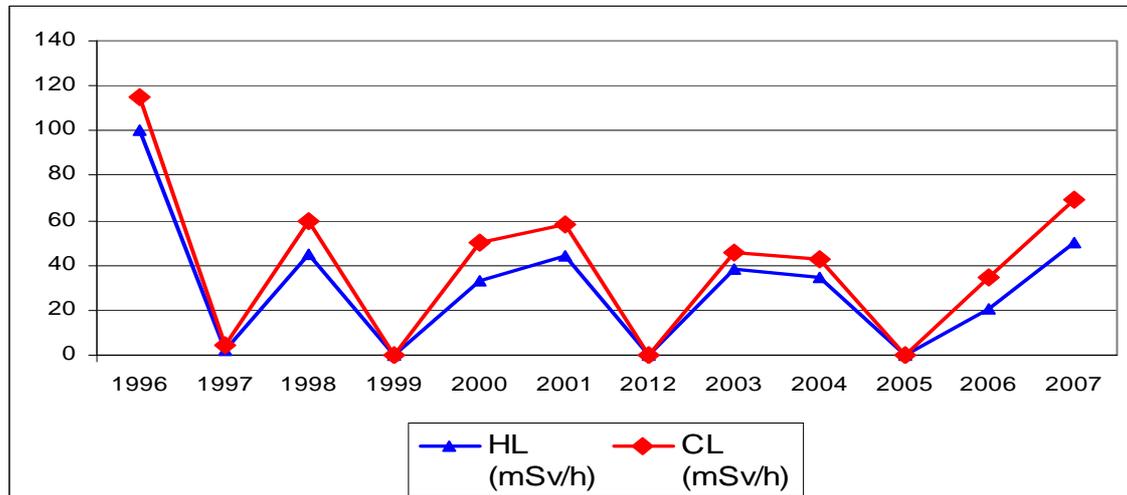


As result of the steam generators replacement, the radiation levels were less than the previous years, as we could see in the next two graphics, that shows the evolution in the radiation levels in the hot-leg and cold-leg (inside the steam generator):

UNIT I



UNIT II



These were keys years for the source term reduction, and with the ambitious reach of ALARA plan, involved an important reduction of collective and personal doses.

With all this information, we could discuss three important phases in Almaraz NPP:

ALARA Past (1997 – 2006)

- **Steam Generators Replacement. Significant source term reduction:** These were discussed before; it's the main radiation levels reduction tasks in Almaraz NPP history.
- **Reactor Vessel Head Replacement:** At the same time that SG replacement, the reactor vessels head were replaced for new ones, decreasing the dose rates and furthermore, the collective dose at opening and closing the reactor vessel.
- **RC-07 Cubicle Design Change (Reactor Coolant Drain Tank & Pumps Room):** This cubicle had a metallic panel which connected the RC-07 cubicle with the RC-08 cubicle (low part of reactor vessel, with high radiation levels) It was necessary in case

of LOCA or hot energy line break. After an evaluation, with the LBB (Leak Before Break) methodology, it could be replaced with a concrete block with a double metallic panel. It reduced the radiation levels in more than 50% in gamma radiation and erases the effect of neutron radiation. This change reduces the collective dose, especially during oil supply in power operation to the pumps of waste liquid treatment system.

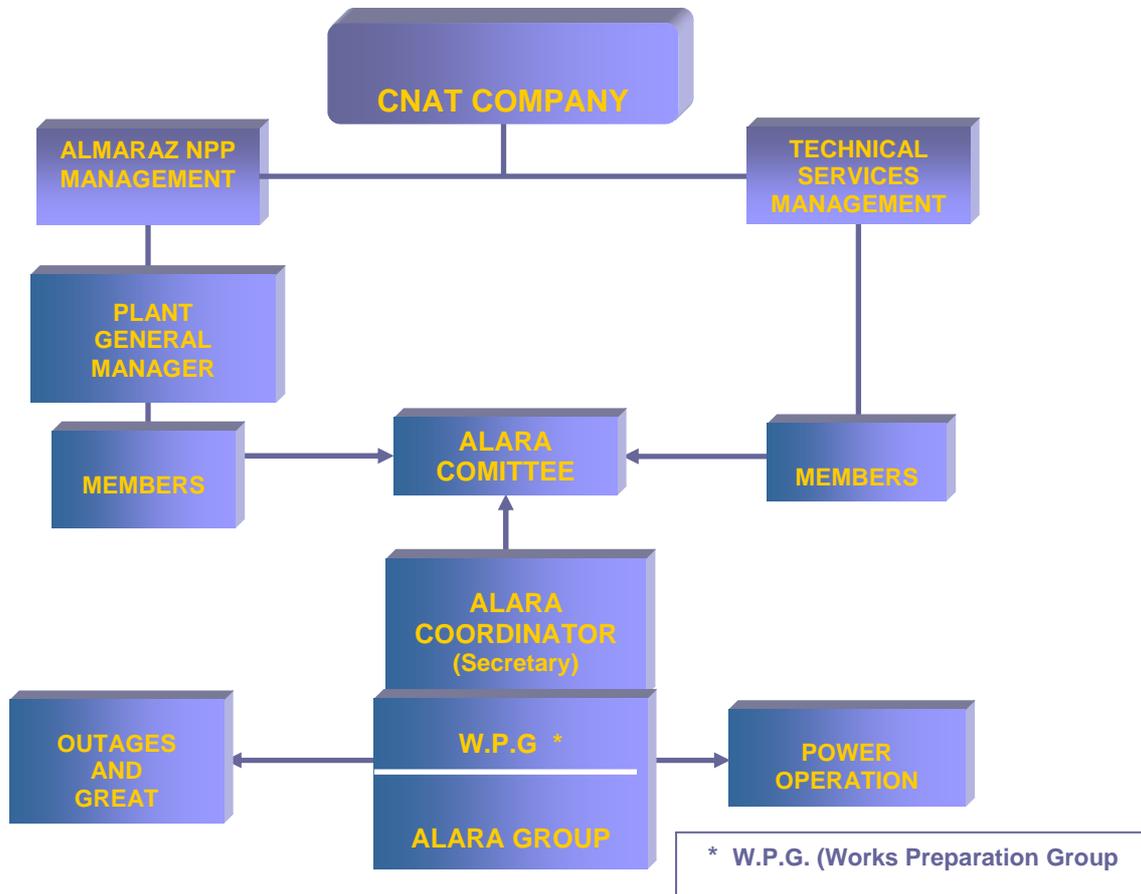


- **Reactor Water System Pipe Design Change:** This pipe takes the reactor water used during the filling up of the reactor cavity for fuel movement. Then the cavity is decontaminated and the contaminated water is took with this pipe to waste treatment or Reactor Water Storage Tank



On those days, ALARA Plan was established with a wide spectrum of tasks and proceedings, which could be resumed in the next:

- To apply the ALARA philosophy at all the levels of the Organization it is created a new figure, the ALARA Coordinator, whose mission is to coordinate and inform about all the ALARA subjects, as much as outage as power operation. In the next figure, we could see that organization:



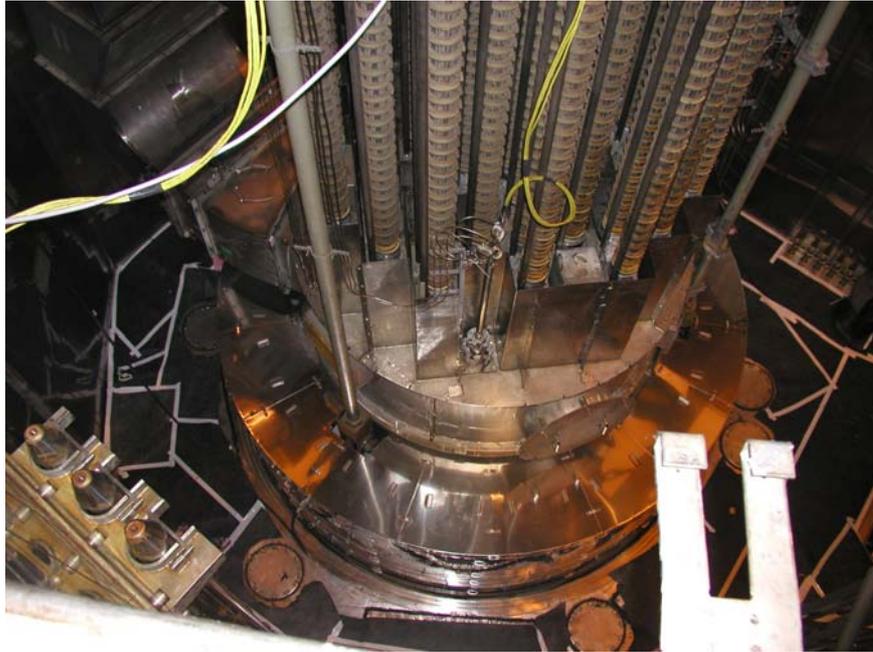
- **Proceedings:** separate proceedings for power operation and outage for ALARA evaluation. ALARA evaluation before, during and after execution works. Seven proceeding are implanted to perform the ALARA philosophy.

In short: high reduction of radiation levels, and improvement in ALARA management.

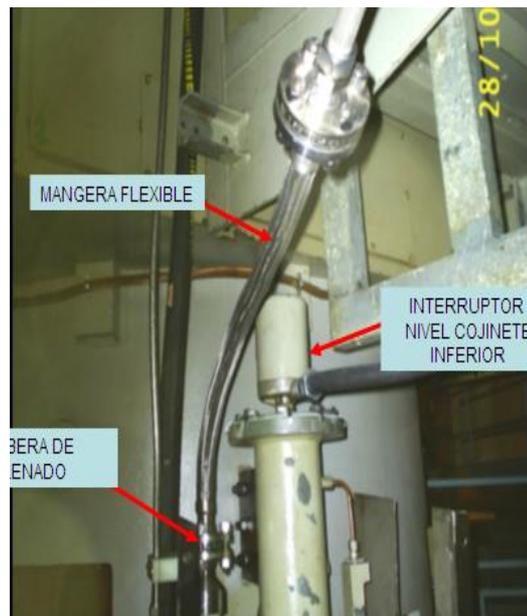
ALARA Now (2007-2009)

Nowadays we are trying to improve the ALARA proceedings, and we continue to suggest design changes like the next ones:

- **Reactor vessel head isolation replacement.** This design change, based in only ALARA basis, will save approximately 80% collective dose during the operation of assembly and withdrawal. Implanted in Unit I (2008)

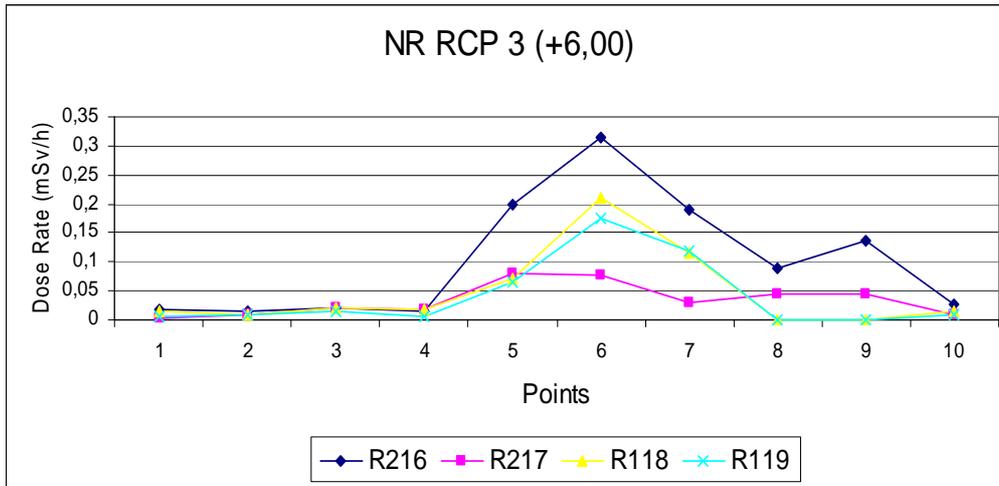


- **Reactor Coolant Pumps Oil Supply Change:** In power operation, sometimes it is necessary to replace oil in the reactor coolant pumps. This supply was taken to a low radiation area to decrease personal and collective doses during the supply operation.



- **Waste Systems Sample System:** replacement of several samplers in waste systems to reduce the dose of workers. Overall, it was performed by take the sampler to a low radiation level area.
- **Human performance and safety culture improvement:** applied in some actions like (Radiation Protection posters, plant guidance posters, different wardrobe for RP and the rest of workers, etc...)
- **Positive re-calculation of collective dose in outage:** reducing the estimated dose by the analysis of radiation levels in some special zones (reactor vessel head, pressurizer,

thimbles cubicle, etc.). We evaluate some points in each case like it showed in the next graphic.



In short: strengthen of ALARA Management and radiation levels reduction with design changes.

ALARA Future (2009- ?)

Although the radiation levels are very low, we are trying to develop new ideas or design changes to improve the dose management and reduce as low as possible the source term. So, these are some of the future thoughts at ALARA management in Almaraz NPP:

- **Source Term Reduction:** by the moment, and due the low levels, we have ruled out the Zn/H₂ injection because it could be increase the dose radiation levels and there isn't guarantee about it in PWR reactors.
- **Improvement in ALARA Management:** integrated software with workflow to manage the ALARA works. That means a computerized management of proceeding connected with NIRPLA software (radiation levels plant software) and ALARA historic data base. (2009-2010)
- **Strengthen ALARA zones:** implanted in some zones at Fuel Outage in May 2008. That means low radiation levels zones with a special poster/sign. This is interesting for tasks with many workers with uncertainty in its development (special operation)
- **Power Upgrading:** shielding calculation, ergonomics searching and optimum Management.
- **New Scale Models** for training (there is existence of steam generator and reactor vessel head scale model)

In short: Strengthen ALARA management with tools for reduce time in analysis and improvement in training. In our opinion, it is quite impossible to reduce the source term.

References:

- ALARA Programme in Almaraz NPP (DAL-28)
- Design Changes Data Base (MDs - SIGE)
- NIRPLA: radiation levels data base in Almaraz NPP
- Outage reports during the period 1995-2008