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Comparison of estimated and actual decommissioning cost of José Cabrera NPP

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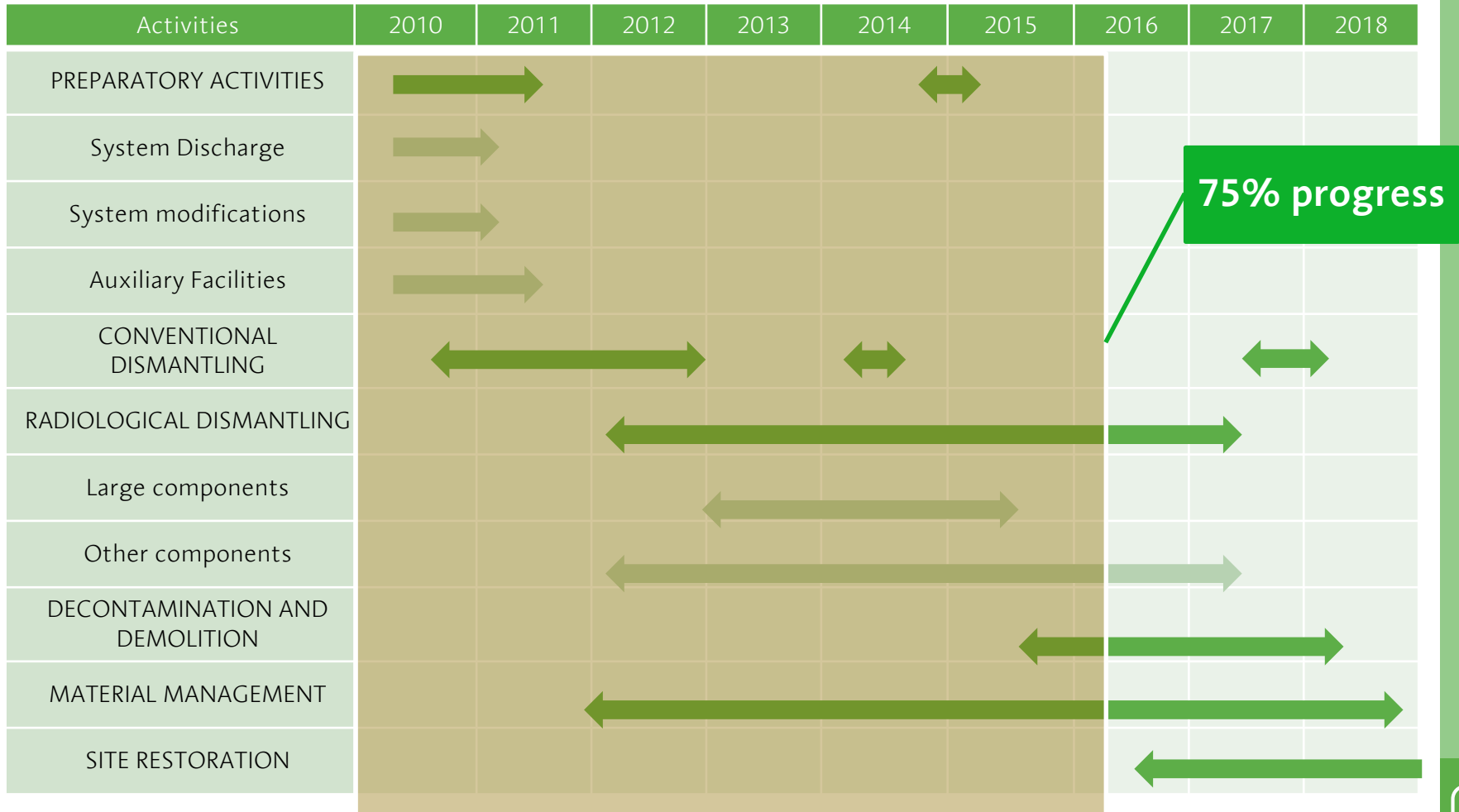
CONTENT

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ROLE OF ENRESA

- **ENRESA** is the responsible entity to develop **decommissioning cost estimates** to feed the **General Radioactive Waste Plan (GRWP)**
- **ENRESA** is also responsible **manager** of the **upfront Fund** to finance the activities contemplated by the GRWP
- **ENRESA is the solely implementer and financer of decommissioning projects:**
 - Vandellos 1 NPP has been partially dismantled being in Safestore today
 - Zorita NPP is currently being dismantled having as objective Greenfield in 2018

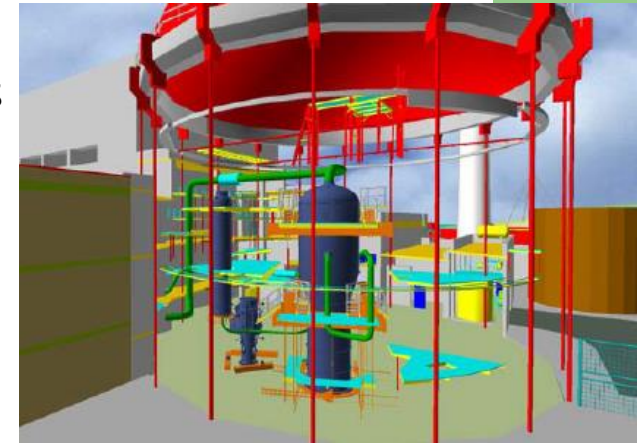
DECOMMISSIONING SCHEDULE



**2003 STUDY: 6 YEARS PROGRAMME
PRESENTLY: 9 YEARS PROGRAMME**

ZORITA PWR DECOMMISSIONING STUDY (2003)

- This study covers the initial process, cost and programme evaluation for decommissioning of the Jose Cabrera 160 MW(e) PWR Nuclear Power Plant.
 - Plant description and zoning
 - International references
 - Inventory of systems, components and structures
 - Physical and radiological inventory
 - Techniques to apply during dismantling
 - Decommissioning material management
 - Programme / scope of dismantling activities
 - Cost estimate
 - Summary and conclusions



BUDGET (Direct decommissioning activities)

PROJECT MAIN ACTIVITIES	Cost (M€ 2003)
-Engineering & Basic Project	34
-Previous Activities after Shutdown + NSSS Decon	5
-Transition Activities (2006-2010)	6
-Dismantling & Decom Execution	29
-Material & Rad Waste Management	11
-Site Restoration	23
- Others	4
- Contingencies	20%
TOTAL	~ 135

PROJECT MAIN ACTIVITIES	Cost estimate 2003 (M€ 2003)	Cost estimate 2003 (M€ 2013)	%
- Pre-decommissioning actions	4	5,2	2,9 %
- Facility shutdown activities	1	1,3	0,7 %
- Procurement of general equipment and material	-	-	-
- Dismantling activities	42	54,2	30,9 %
- Material & Rad Waste Management	11	14	8,1 %
- Site security, surveillance and maintenance	13	17	9,6 %
- Site restoration, cleanup and landscaping	31	40	22,8 %
- Project management, engineering and site support	29	37,4	21,3 %
- Fuel and nuclear material	-	-	-
- Other costs	5	6,5	3,7 %
TOTAL	136	175,6	100%

UPDATED COST ESTIMATE

(real executed works 2006-2013 + Budget 2013-2017)

COST ITEM	COST (M€ 2014)	%
Pre-decommissioning	12,8	5,9 %
Facility shutdown	4	1,8 %
Dismantling activities within controlled area	42	19,3 %
Waste processing, storage and disposal	10	4,6 %
Site infrastructure and operation	66	30,3 %
Conventional Dismantling, Demolition, site restoration	15	6,9 %
Project Management, Engineering, Site Support	53	24,3 %
Fuel and Nuclear Material	-	
Miscellaneous Expenditures	15	6,9 %
TOTAL	217,8	100 %

SAME SCOPE BUT SOME DIFFERENT DISMANTLING TECHNIQUES

	2003 STUDY	EXECUTED
REACTOR INTERNALS	Underwater with plasma and abrasive water jet cutting	Underwater with mechanical tools
REACTOR VESSEL	Segmented in air with thermal cutting	Underwater with mechanical tools
STEAM GENERATOR	Removal as a single piece and segmented elsewhere on site	Segmented in situ

SOME EXPERIENCES AND LESSONS LEARNT

DIFFICULTIES ENCOUNTERED

- Systems of the Plant (Ventilation particularly) were in a worse condition than initially preview. This situation provoked additional works (repair tasks of existing systems, design modifications, exhaustive test plan, etc.) in order to comply with regulatory requirements.
- Some of the contractors were not used to work in nuclear sector. They had problems to prepare suitable documentation (supplementary control and support by the Site Organization and Engineering)
- New requirements due to a change in regulation.
- Delay on the delivery of some equipment (portable ventilation units, new emergency fire fighting pump, etc.)



SOME EXPERIENCES AND LESSONS LEARNT

DIFFICULTIES ENCOUNTERED (DISMANTLING AUXILIARY BUILDING)

- ADDITIONAL WORKS

- Increase of waste storage area capacity (new foundation, thickness of the slab, additional cutting activities with diamond wire ,etc.)
- Waterproof tasks on the building roof.
- Improvements related with industrial safety requirements.
- Support from the contractor to discharge electrical systems (deviation of cable trays, etc.)

- EQUIPMENT AND SUPPORT SYSTEMS

- Reinforcement of ventilation system (Regulator requirement). Extra cost due to new equipment (ventilators, nuclear filters, etc). Lessons learnt after the adaption of ventilation system from Auxiliary and Reactor Buildings
- Modification of equipment according to improvements detected during Test Plan (control room, concrete injection area, shielding bell, etc.)

- ORGANIZATIVE ASPECTS

- Interferences between the different contractors working on the same time.



SOME EXPERIENCES AND LESSONS LEARNT

REACTOR INTERNAL SEGMENTATION

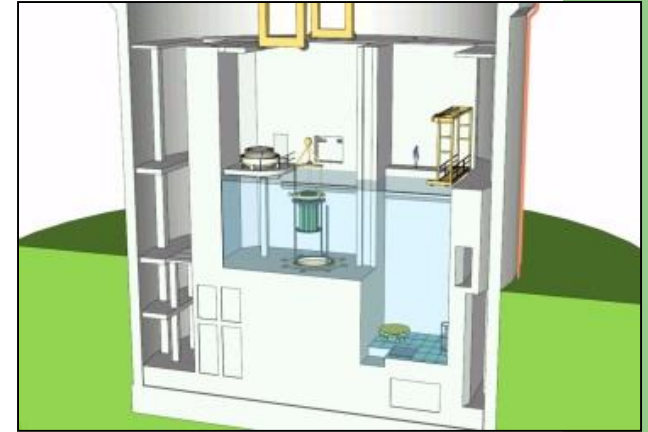
- **Preparatory activities** were more complicated than expected (**delay of 6 months**)

ACTIVITIES NOT CONSIDERED IN TECHNICAL SPECIFICATION

- Spent fuel **pool liner repair**
- Exhaustive underwater inspection of spent fuel pool
- Removal of miscellaneous elements from pool (racks, operational components)
- Manufacturing of “Insert” (intermediate container for activated pieces)

ACTIVITIES MORE COMPLEX THAN EXPECTED

- Removal of wall between Reactor Cavity and Pool
- Tasks to **assure waterproof of cavities**
- Filtration of water from cavities to **achieve optimal visual conditions** for segmentation activities



CONCLUSIONS

- **PRELIMINARY RESULTS**
 - **No significant deviations in cost related with dismantling activities**
 - **Labour costs** (operation and maintenance of the site, project management, support services) **were underestimated. Cost very sensitive to programme delays**
 - **Differences can be explained because cost estimates were produced at different points of the project (conceptual design / execution)**
- **VALUABLE INFORMATION TO IMPROVE COST ESTIMATE FOR FUTURE DECOMMISSIONING PROJECTS**



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