



NUCLEOELECTRICA ARGENTINA S.A.
Life Extension Project Management
Embalse Nuclear Power Plant

Embalse Life Extension Project



CONFERENCIA LATINOAMERICANA DE LA ENERGIA NUCLEAR

October 25/26th, 2016.

BUENOS AIRES , ARGENTINA

R. O. Semmoloni, Eng.



Embalse NPP Life Extension Project

Contents

1. Introduction

- Main characteristics of Embalse NPP

2. Overall Description of Embalse NPP Life Extension Project

- Objective
- Overall guidelines.
- Legal frame.
- Project Phases.

3. Project Scope

- Reactor Retubing.
- Replacement of 4 Steam Generators.
- Facility Updating.
- Power uprating.

4. Present Situation. Schedule

5. Cost and financing.

6. Concluding remarks

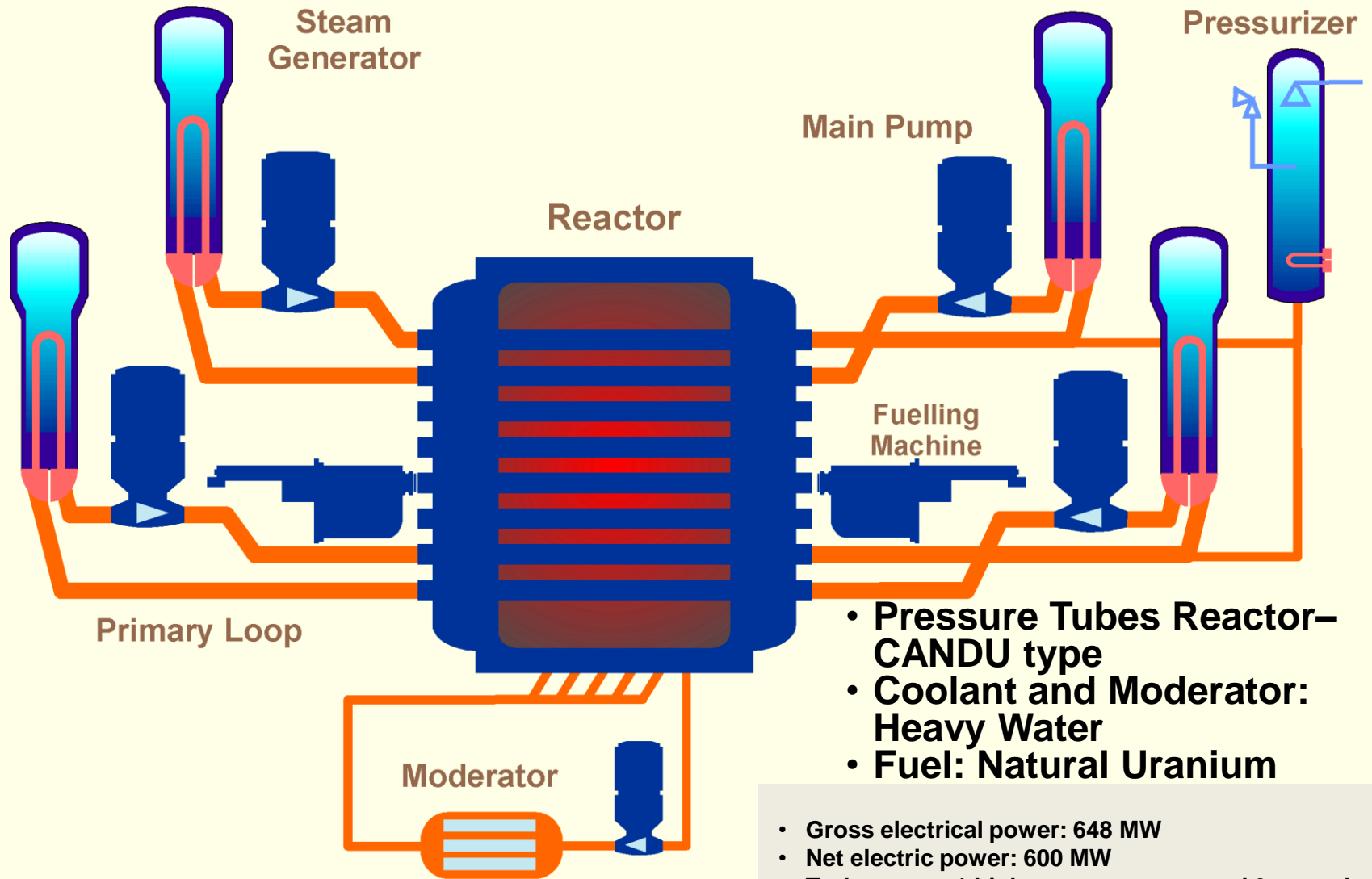


CNE Important Milestones

- **CONTRACT SIGNATURE: DECEMBER 20th, 1973**
- **WORKS BEGAN: MAY 7th, 1974**
- **ERECTION ENDED: BY MID 1981**
- **FIRST CRITICALITY: MARCH 13th, 1983**
- **FIRST NET CONNECTION: APRIL 25th, 1983**
- **100 PER CENT POWER: SEPTEMBER 15th, 1983**
- **COMMERCIAL OPERATION FIRST CYCLE : JANUARY 1st, 1984**
- **COMMERCIAL OPERATION FIRST CYCLE END:
DECEMBER 31st, 2015**



CNE Main Characteristics



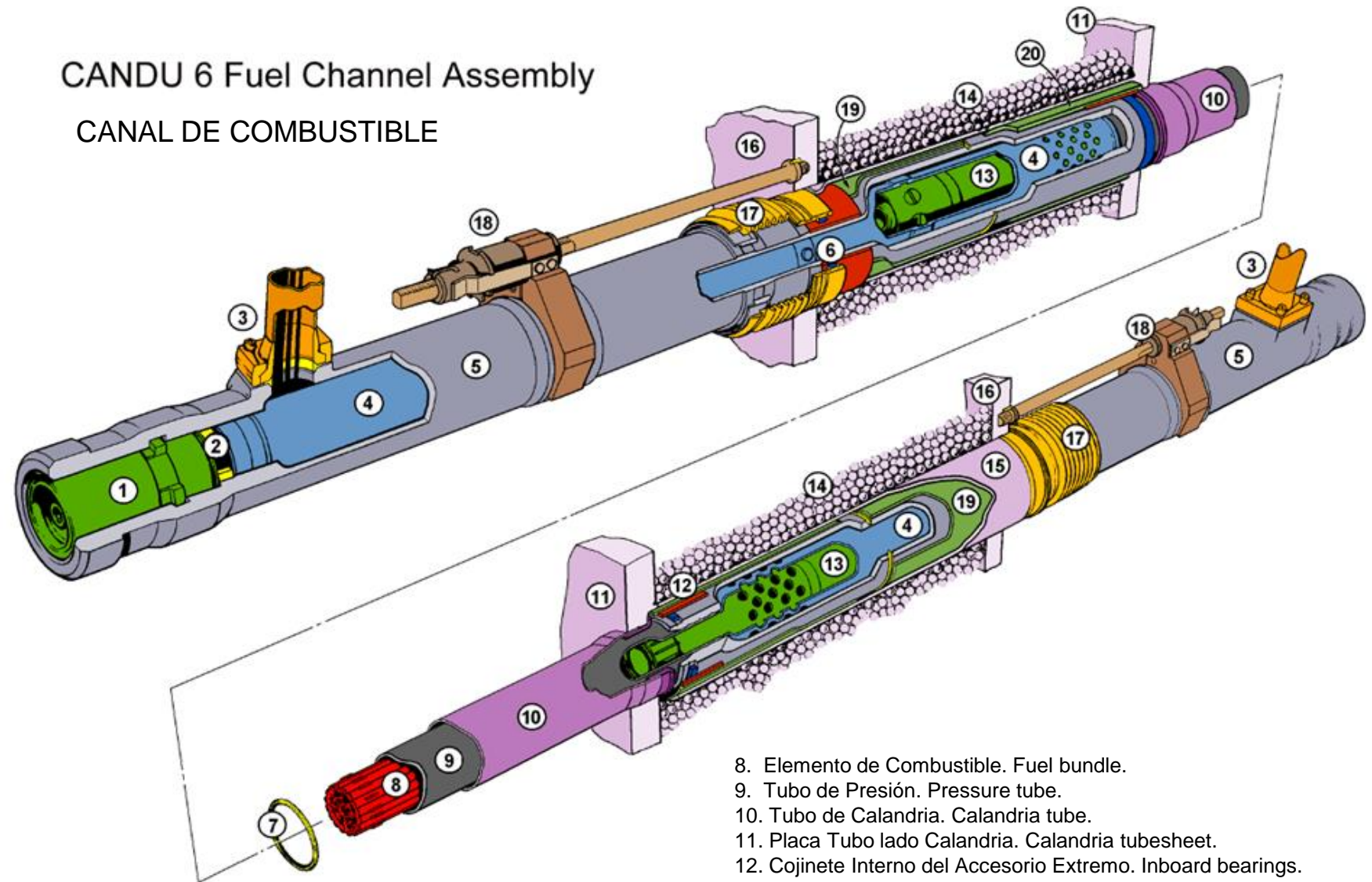
- **Pressure Tubes Reactor– CANDU type**
- **Coolant and Moderator: Heavy Water**
- **Fuel: Natural Uranium**

- **Gross electrical power: 648 MW**
- **Net electric power: 600 MW**
- **Turbogroup: 1 high pressure stage and 3-stage low pressure.**
- **Three phase generation 21 KV , 50 Hz**
- **Transformation to 500 KV 50 Hz.**

PRIMARY LOOP & MODERATOR

CANDU 6 Fuel Channel Assembly

CANAL DE COMBUSTIBLE



1. Tapón de Cierre. Channel Closure
2. inserto de Sello de Cierre. Closure seal insert.
3. Acoplamiento del Alimentador. Feeder coupling.
4. Tubo de Revestimiento. Liner tube.
5. Cuerpo del Accesorio Extremo. End Fitting body.
6. Cojinete Externo del Accesorio Extremo. Outboard bearings.
7. Anillo Separador. Annulus spacer.

8. Elemento de Combustible. Fuel bundle.
9. Tubo de Presión. Pressure tube.
10. Tubo de Calandria. Calandria tube.
11. Placa Tubo lado Calandria. Calandria tubesheet.
12. Cojinete Interno del Accesorio Extremo. Inboard bearings.
13. Tapón de Blindaje. Shield plug.
14. Bolitas de Blindaje del Blindaje Externo. Endshield shielding balls.
15. Tubo del Blindaje Externo. Endshield lattice tube.
16. Placa Tubo lado Maquina de Recambio. Fuelling tubesheet.
17. Fuelle Anular del Canal. Channel annulus bellows.
18. Elemento Posicionador del Canal. Positioning Assembly.
19. Manguito de Blindaje del Accesorio Extremo. End fitting shielding sleeve.
20. Manguito de Blindaje (Lattice Tube). Lattice tube shielding sleeve.

Life Extension Project Embalse NPP. Objectives

- Extend the life of the NPP for another 30 years.
- To adapt the system to the new regulatory requirements.
- Increasing the electrical power

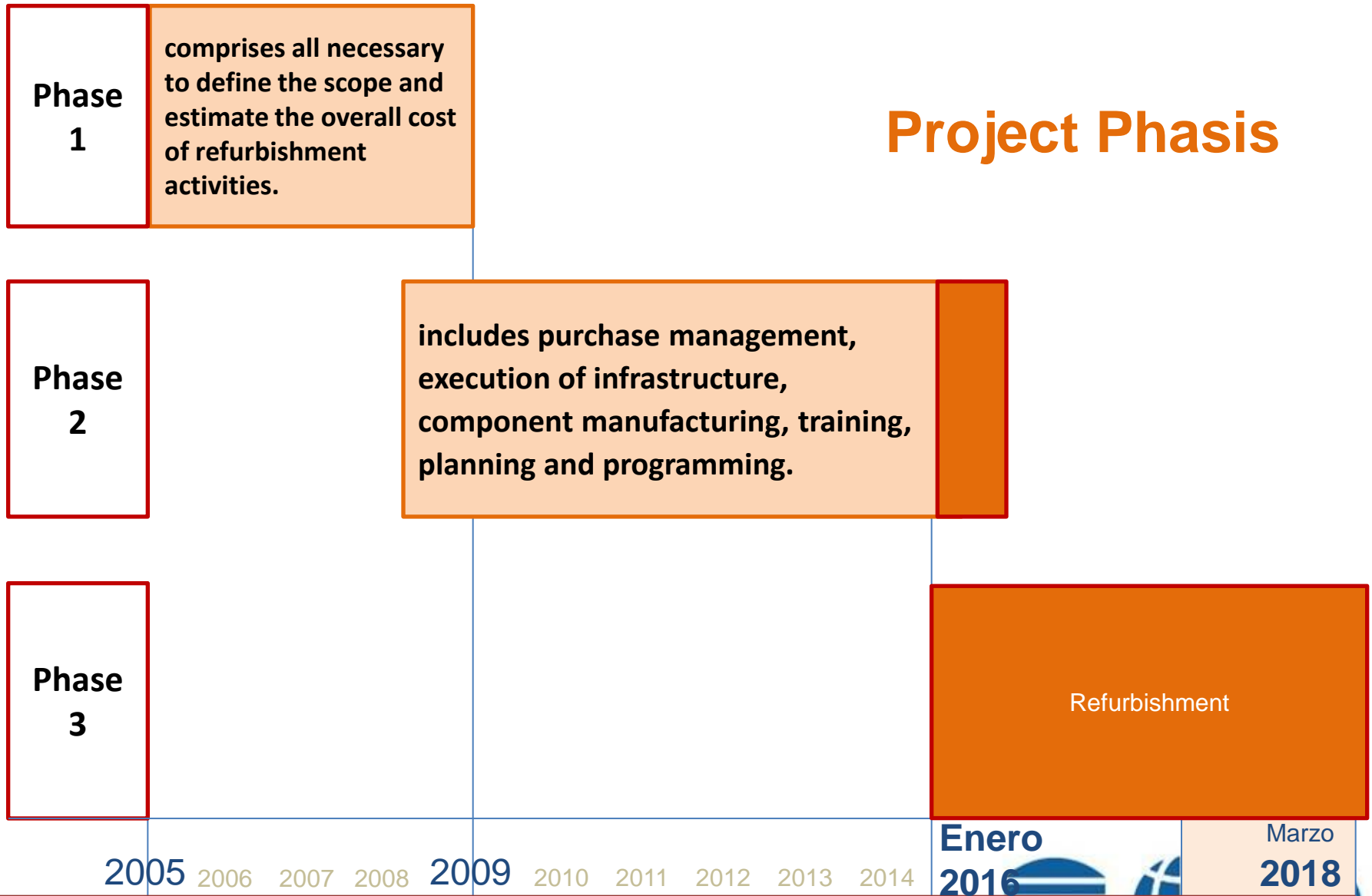


General Guidelines Project

- Integrated Project Management under the responsibility of NASA.
- Participation of the designers of nuclear and conventional island.
- Development and qualification of domestic suppliers.



Project Phasis



Project Scope

Fuel Channel and Feeders Replacement

Steam Generators Replacement

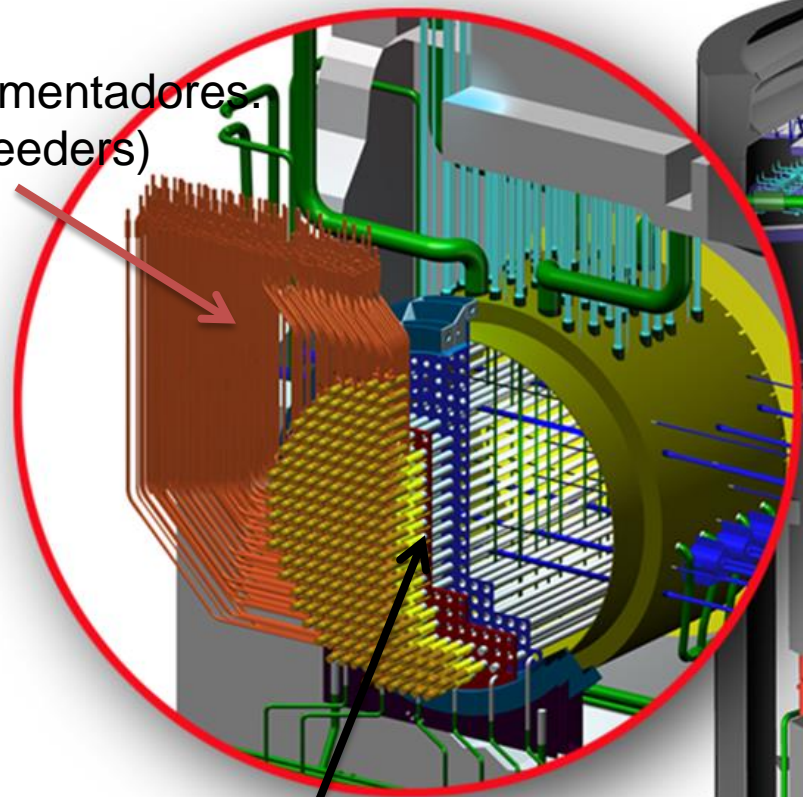
Power Up- rate

Update / improvements to the safety of the Nuclear Power Plant

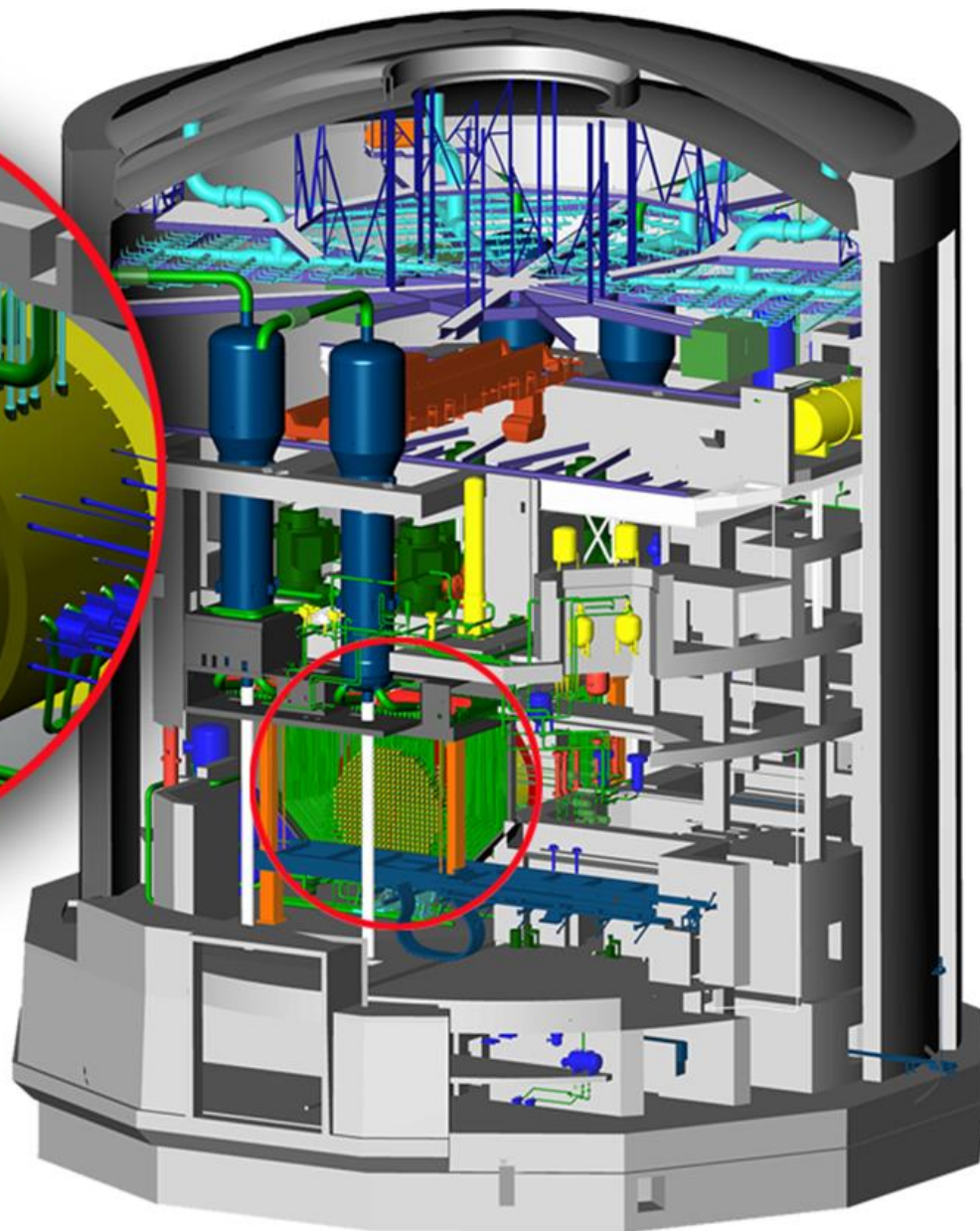


Fuel Channel and feeders Replacement

Alimentadores.
(Feeders)



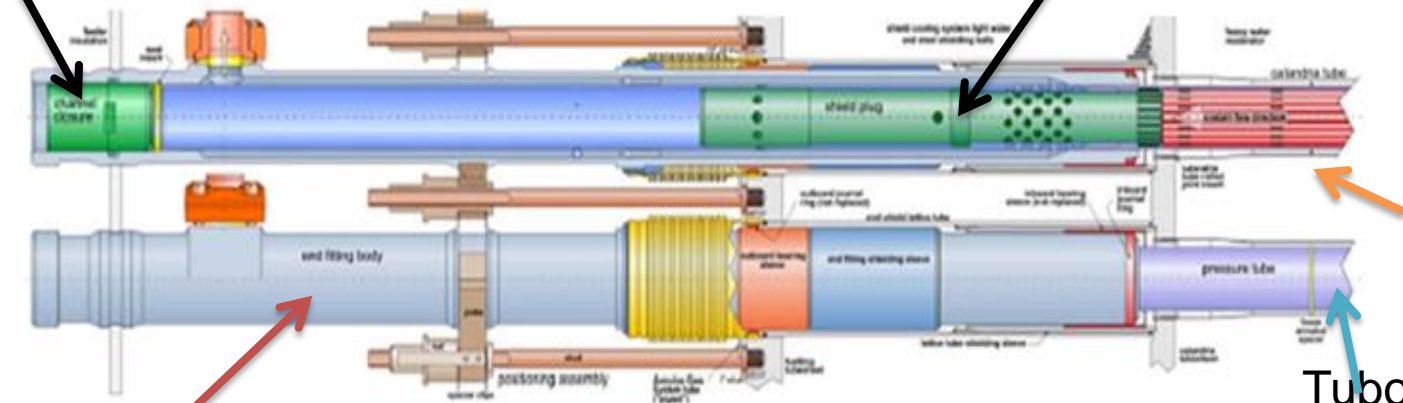
Canales Combustibles
fuel channel



Retubado. Fuel Channel and feeders Replacement

Tapón de Cierre (Channel Closure).

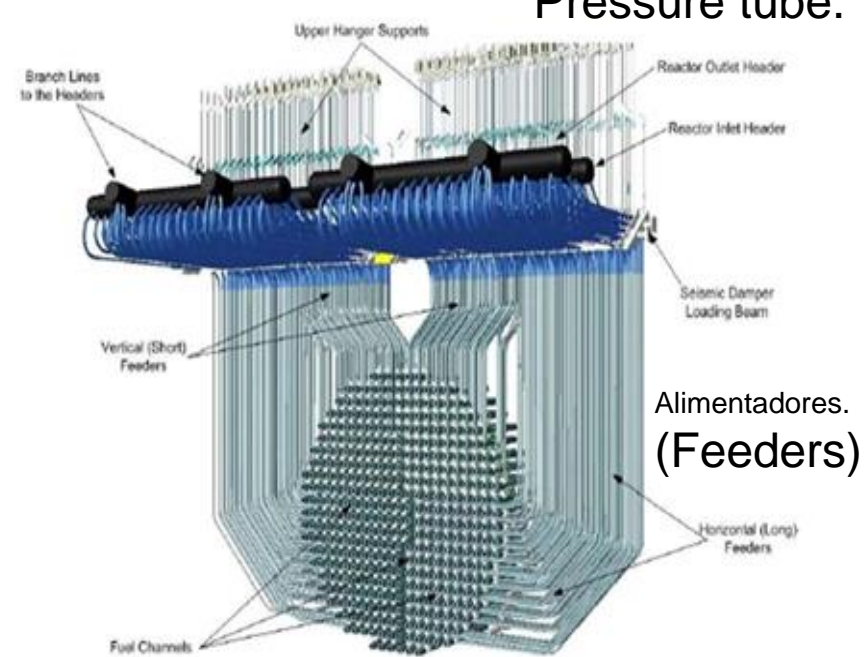
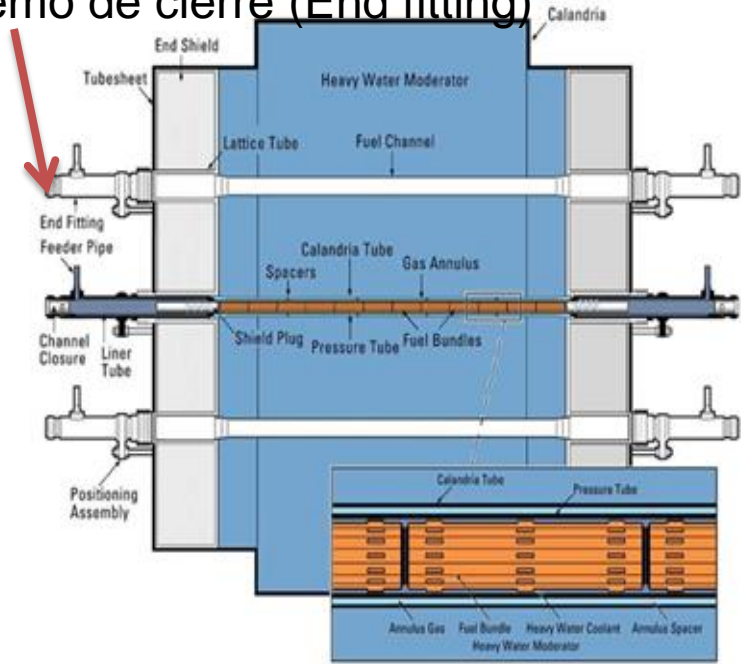
Tapón de blindaje (Shield Plug)



Tubo de Calandria. Calandria tube.

Tubo de presión, Pressure tube.

Extremo de cierre (End fitting)



Alimentadores. (Feeders)

Reactor Retubing

Reactor Components

End-fittings, Calandria tubes, Shield Plugs, Pressure Tubes, Feeders, End fittings

Special Tools and Equipment.
Staff Training.

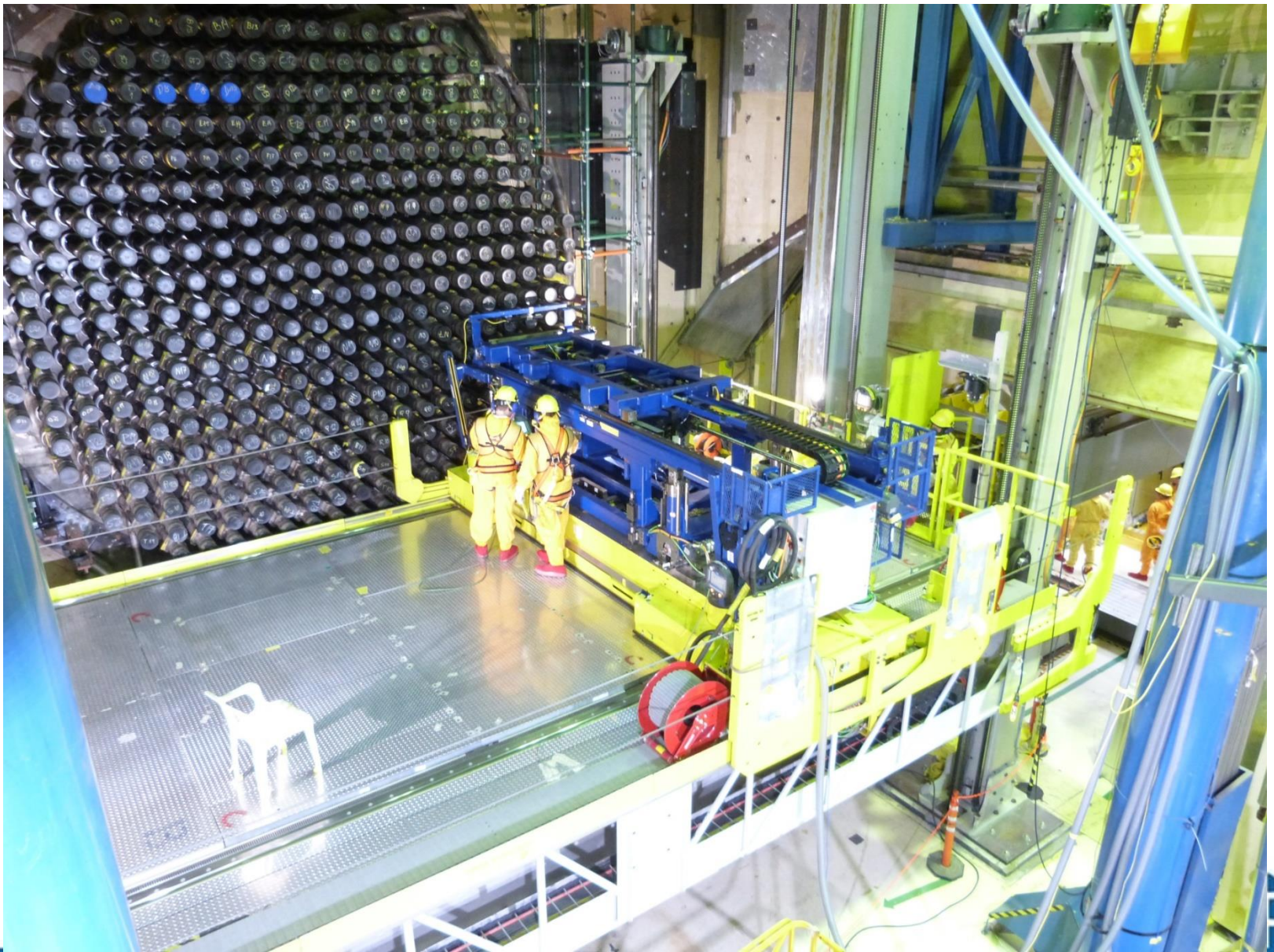
Mock-up for Training

Auxiliary Installations

Construction and renovation of approx. 8000 m² of storage facilities for reactor components, tools, making feeders, staff training. Canisters and storage containers for radioactive waste discharged (pressure tube, calandria tube, End fittings).

- Facilities and containers for radioactive waste storage medium and low.



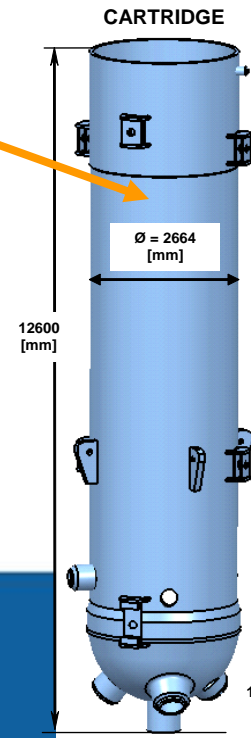
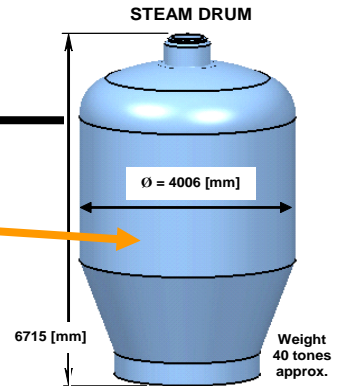


Steam Generators Replacement

312 new primary moisture separators manufacture

4 new replacement cartridges manufacture:

Storage facility used cartridges



Steam Generators Replacement

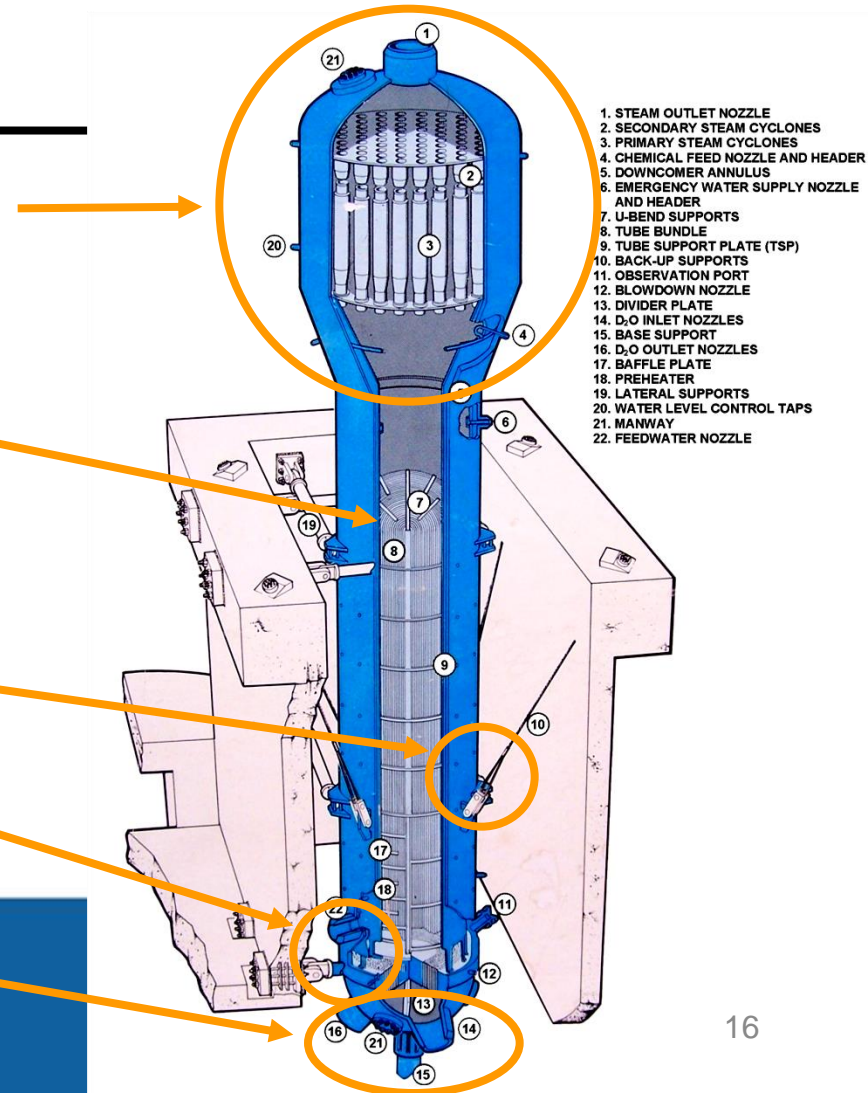
Cut steam drum and replacement of 312 primary moisture separators.

Cartridges Replacement through the airlock equipment.

Back-up Supports Replacement

Modifying lower side supports

Cut and Welding Primary lines





POWER UP-RATE

■ Up-rating assessment for the NSP:

- Thermal power up-rating from 2015 MWt up to 2064 MWt
- Safety Report review

■ Up-rating assessment for the BOP :

- Two additional High Pressure Pre-heater
- Two additional booster pumps in the circuit
- Steam Generators Feed-water temperature ingress increase from 158°C up to 188°C
- Rotor change with new forged discs



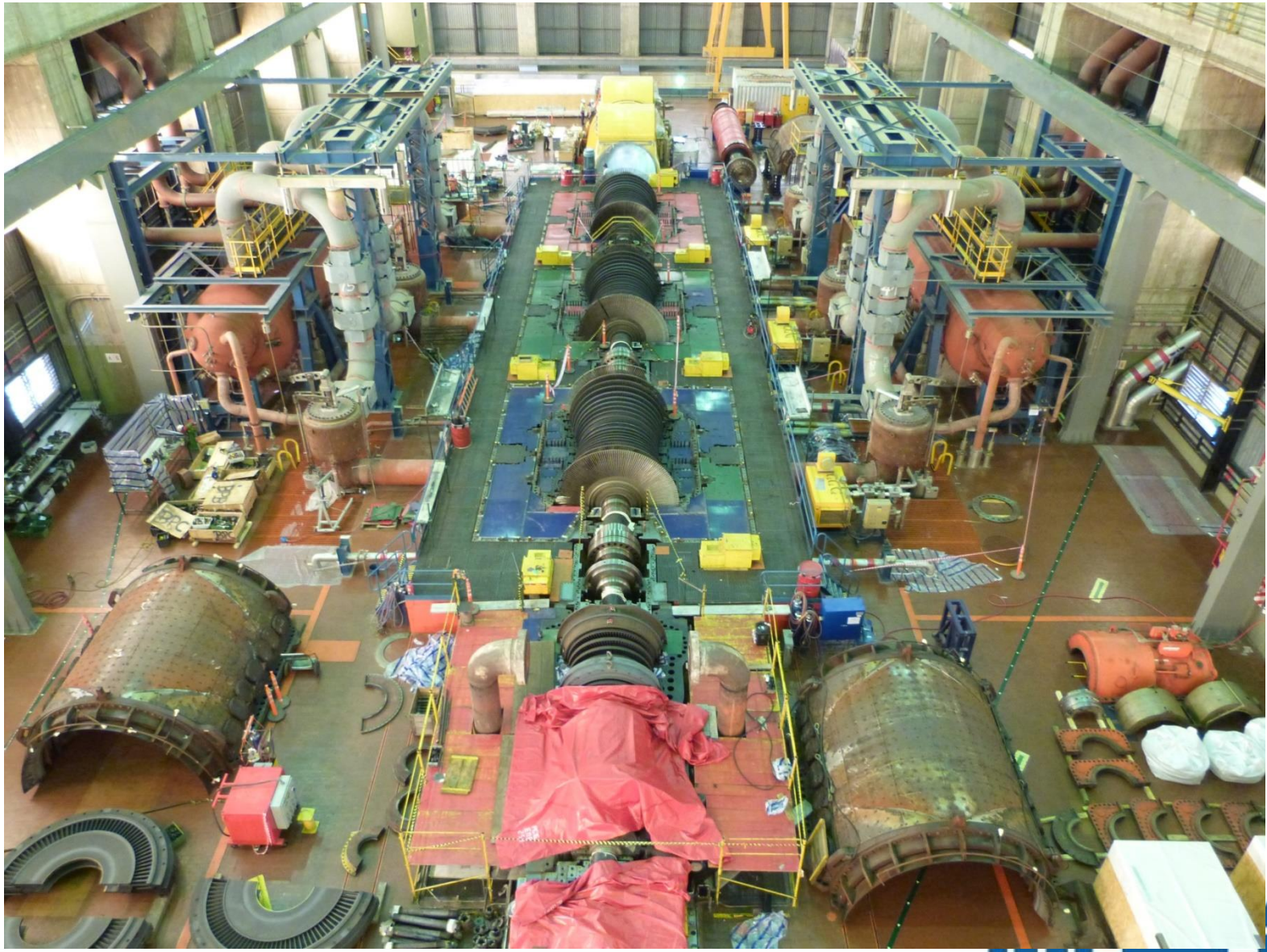
POWER UPRATE

Increased electric power 35MW

		MWt	Mwe	incr. Mwe
1	Present Configuration	2015	648	
2	Efficiency Improvement of BOP and Turbin/Generator	2015	656	+ 8
3	NSP Power Increase	2064	670	+ 14
4	5th Pre-heater	2064	683	+ 13
	Final Configuration	2064	683	35

Total Increase: from 648 to 683 MWe (+ 35)





Update / improvements to safety of the Nuclear Power Plant

- **Improvements in safety systems**
- (Shutdown System No. 1 and No. 2,
- EPS, (Emergency Power System)
- ECC, (Emergency Core Cooling System)
- EWS (Emergency Water Supply System)
- Installation of passive catalytic hydrogen recombiners (PAR) in the reactor building.
- Installation of a filtered venting system and controlled containment.



Actual vs. Planned Progress - PEV

Date:

29/09/2016

ACTIVITIES		Progress	Planned	
Previous Activities CNE		1,90%	1,90%	
1 - Fuel Channel And Feeders replacement		4,97%	5,84%	
2 - Steam Generators		2,72%	5,18%	
3- Installation Update.	IyC Systems Assembly	3.1 - Nueva Computadora de Control DCC	0,49%	0,62%
		3.2 - Programa de Calificación Ambiental (EQ)	0,13%	0,57%
	Electric Systems Assembly	3.3 - Nuevos Diesel Clase III -	0,97%	1,48%
		3.5/3.6/3.7/3.8 - Tareas de Montaje Eléctrico	1,07%	1,09%
	Engineering	3.9 - Modificaciones ECC	1,00%	3,47%
		3.10 - CV-RD	0,02%	0,36%
		3.11 - EWS	0,95%	3,13%
		3.12 - EPS	0,92%	2,22%
		3.13.1 - SDS1	0,37%	0,90%
		3.13.2 - SDS2		
		3.13.3 - ROP 1		
		3.13.4 - ROP		
		3.13.5 - DISPARO DE BOMBA SPTC		
		3.14 - PARs	0,00%	0,00%
	3.15 - Sistema de Venteo Filtrado de la contencion	0,09%	0,55%	
	Mechanical Systems Assembly	3.16 - INSPECCION BOMBAS PRINCIPALES	0,00%	0,00%
		3.17 - INSPECCION BOMBAS REFRIGERACION DE PARADA	0,28%	0,45%
		3.18 - SISTEMA MODERADOR	0,68%	0,83%
		3.19 - INSPECCION BOMBA ECC	0,00%	0,00%
		3.20 - (Válvulas MSSV, ASDV, LCV y soportes MSL)	1,47%	1,56%
4 -Power Uprate		4,96%	6,22%	
Final Tasks CNE		0,00%	0,00%	
TOTAL		22,99%	36,37%	



5. Cost and Financing

- Estimated total cost: USD 2.149 million
- **Financing Sources:**
 - Non-reimbursable contributions from the National Treasury
 - NASA Series II Financial Trust Fund
 - CAF Loan
- **Funds Management:**
 - «Embalse NPP Life Extension Project Trust Fund»
 - Trustee: Banco de Inversión y Comercio Exterior SA (BICE)



NASA Series II Financial Trust Fund

- Contract signed : May 2012 : Issuance of Debt Securities (VRD A) for the amount of USD 189.4 million
- Main investor: Banco de la Nación Argentina.
- Interest rate: Libor (180 days) + 500 p.b
- Amortization: 10 years (4/2014- 4/2024)
- Trusted Assets: 80% future energy generated by the NPPS (CNA I, CNAII , CNE). (Purchase Agreement signed by NASA and CAMMESA).



CAF Loan

(Banco de Desarrollo de América Latina)

- On February 6th. 2013, a Loan Agreement was signed between CAF and the Argentine Republic amounting to USD 240 million for the partial financing of the Embalse NPP Life Extension Project.
- During 2013 disbursements (two) were made for a total amount of USD 96 million.
- In May 2014 a third disbursement amounting to USD 50 million was made.



CAF Loan

- Amount **240 million u\$s**
- **Interest rate: LIBOR for loans to 6 months+ 2.40%**
- **Grace period: 4 years**

- Conditions during disbursement period: present quarterly reports with progress; cost; finance plan; Schedule of investments.

- **Loan Amortization: 28 semiannual installments, consecutive capital and equal as possible, which will add accrued interest at maturity of each one. The first is paid at 54 months of signing the contract.**

- Commitment Fee. 0.25% per year on undisbursed balances
- Financing Commission: 0.75%
- Evaluation costs: 100.000 U \$ S



Disbursements up to Sept. 30, 2016

(USD million)

	Up to 2011	2012	2013	2014	2015	by 09/30/16
Per YEAR	196	362	336	245	249	139
ACCUMULATED	196	558	894	1.139	1.388	1.527



Concluding / Remarks:

- Recovery of domestic capacities
- Development of Suppliers

Development of the
manufacturing of
components

Development of Engineering
and Erection Services

A bridge towards the new Nuclear Projects.



Muchas Gracias

