# Comisión Nacional de Energía Atómica

## EQ activities in Argentina


Jorge Zorrilla zorrilla@cnea.gov.ar

Daniela Yllañez yllanez@cnea.gov.ar

# Main Organizations

- State owned R&D Institution
- Research reactors, radioisotope production and technology update of NPP
- CAREM Project

- State owned Utility
- Operation and Maintenance of NPP

- Regulatory Body
- National authority for all nuclear facilities in the country

# EQ Status in Argentina

## Atucha I (Pressure Vessel Heavy Water Reactor)

Original design did not take into account EQ requirements

An EQ programme is introduced for LTO period (~2023)

Original Equipment
- replaced
- tested / qualified

## Atucha II (Pressure Vessel Heavy Water Reactor)

Original design included qualified equipment

EQ Preservation

# EQ Status in Argentina

Embalse (CANDU 6)

Original design did not take into account EQ requirements

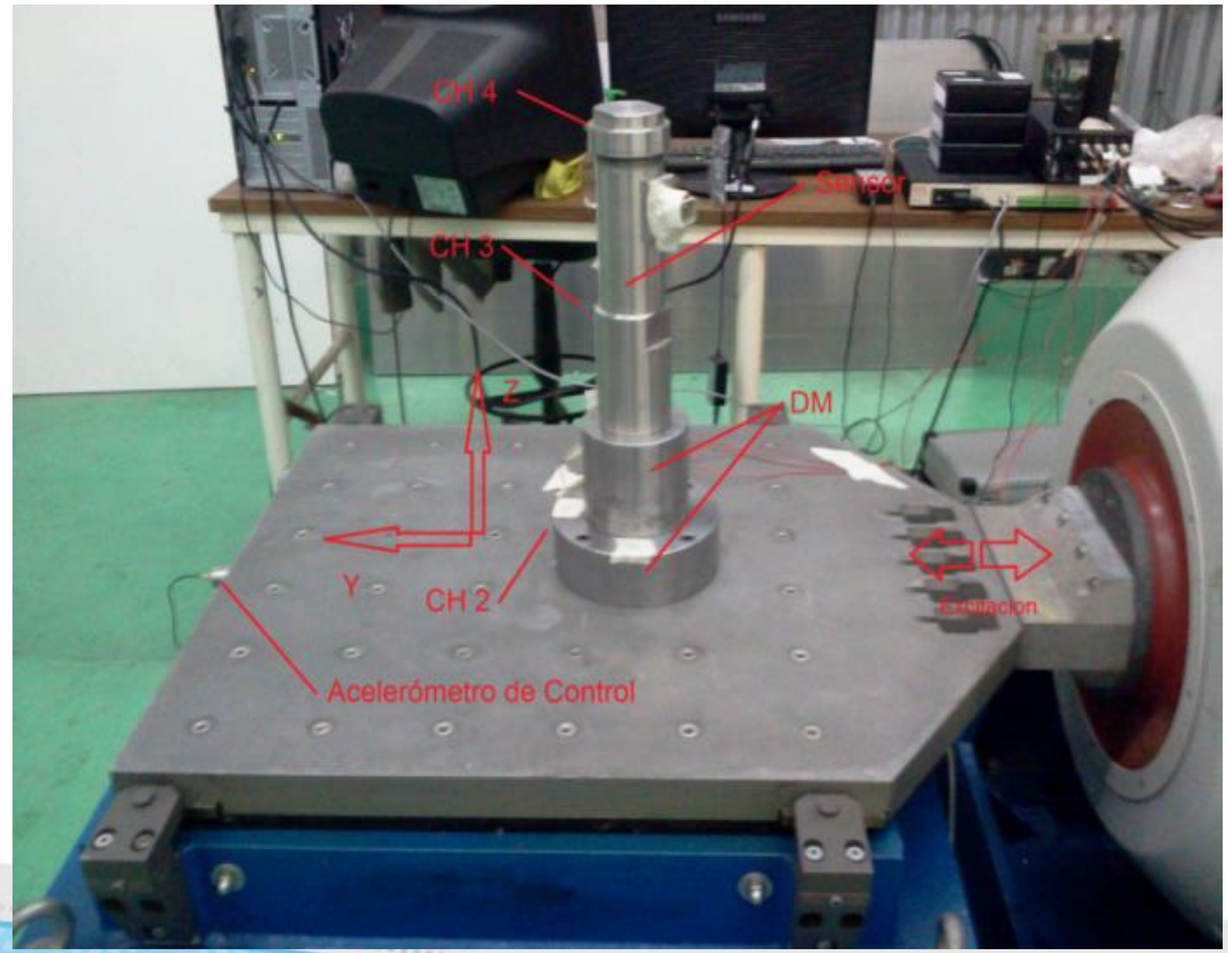
Refurbishment outage finished in December 2018.

EQ programme was introduced for LTO period.

Effort is in EQ preservation

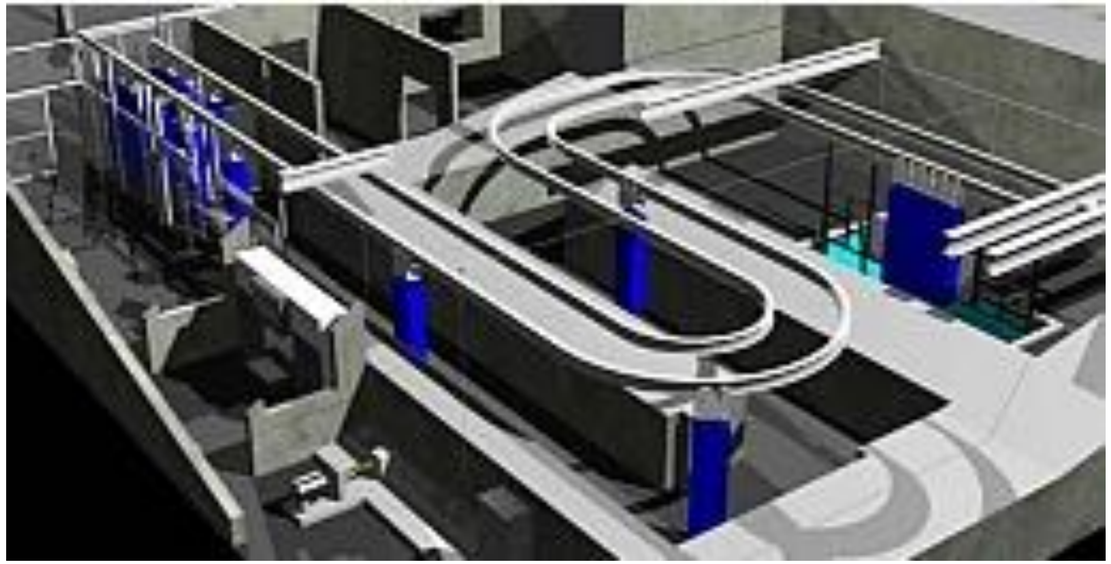
# Seismic test facility

- Shaker with a maximun load capacity of 11 kN – nominal frequency from 5 to 3500 Hz – peak to peak displacement of 50.8 mm.
- Vibration Exciter with a maximun load capacity of 110 N.
- Data acquisition and analysis systems with more than 32 channels.
- Shaker driver with 4 control channels.
- Signal conditioning / Amplifiers units for different type of transducers.
- Miniature accelerometers (0.5 pC/g).
- General purpose and industrial type accelerometers (99.09 pC/g and 242 mV/g).
- Triaxial accelerometers (96 mV/g and 10 pC/g).
- High sensivity (seismic) accelerometers (10156 mV/g).
- Strain, displacement  and velocity (laser) transducers.
- Reference vibration generator  and reference signal generator for transducer verification.



# Irradiation ageing: PISI

## Semi Industrial Irradiation Plant (PISI)



*Planta de Irradiación*
*Centro Atómico Ezeiza*

CERTIFICADO DE IRRADIACION

EMPRESA: *C.A.C. – CCIA. CORRO. PROY. CNEA-NASA*
TIPO DE PRODUCTO: *CABLES*
REMITO Nº: SOLICITUD Nº: *56M/14*

| PARTIDA/LOTE del CLIENTE | PRODUCTO | CANTIDAD |
|---|---|---|
| Según solicitud de servicio | CABLES | 1 rollo |
| | TOTAL | 1 rollo |

COMIENZO DE IRRADIACION (LOTE Nº/FECHA): *//18/09/14*
FIN DE IRRADIACION (LOTE Nº/FECHA): *//19/09/14*

TIPO DE DOSIMETROS UTILIZADOS: *Red Perspex*
CODIFICACION DOSIMETROS: *CAC 794 al Mile into-max*

DOSIS MINIMA SOLICITADA: *289 kGy*
DOSIS MAXIMA SOLICITADA: *kGy*
DOSIS MINIMA RECIBIDA: *221 kGy*
DOSIS MAXIMA RECIBIDA: *kGy*

Fecha: 30 SEP 2014

Typically, total accumulated dose during service life + accident dose are replicated at PISI.

Radioactive source: 60Co with a maximun activity of 1.000.000 Ci

# Thermal ageing: drying and heating chambers

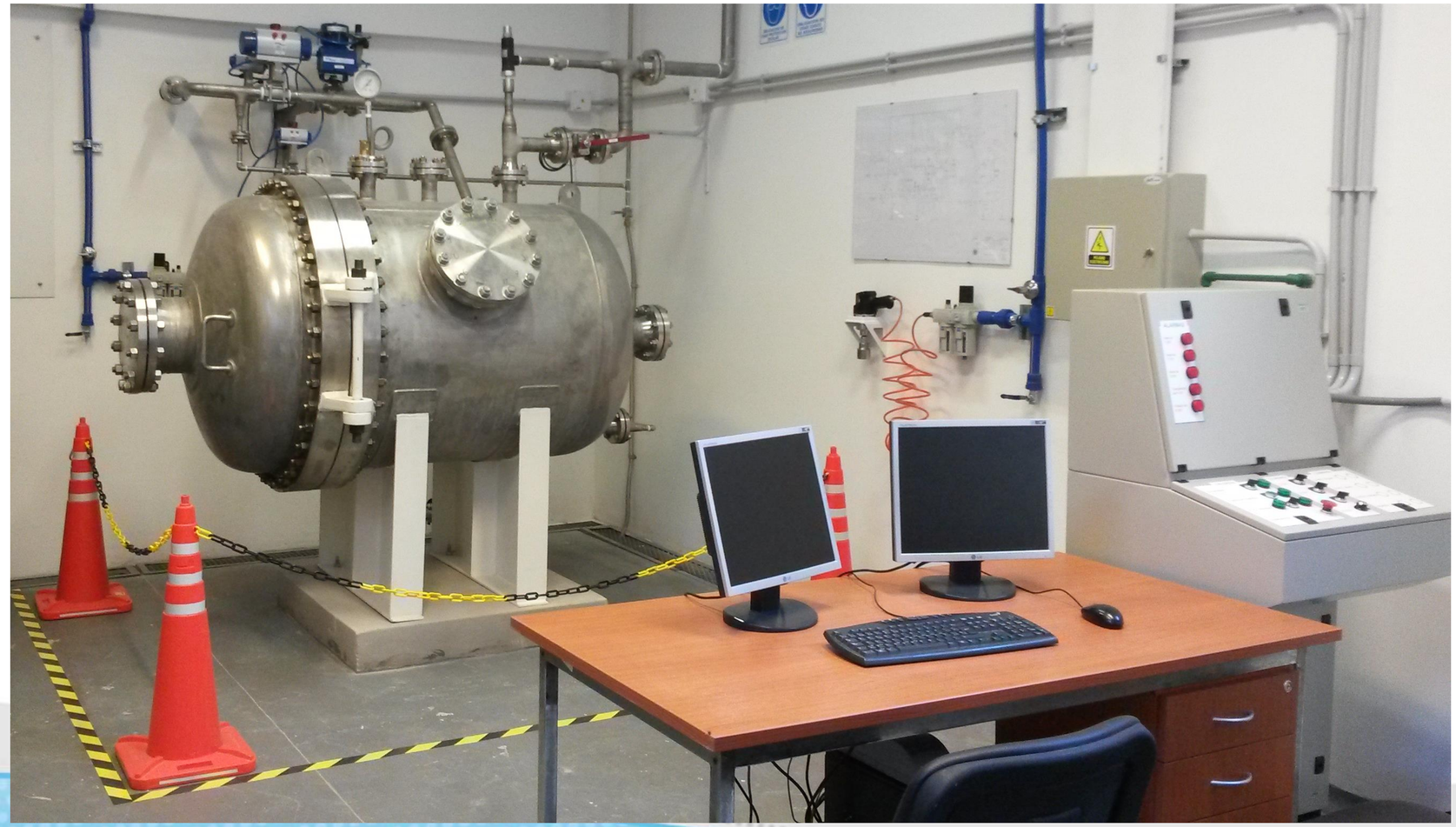
- Binder (series FED) drying and heating chambers with forced convection.
- Models FED 53 / FED 720
- Inner volume: 53 l / 720 l
- Temperature range: ambient temperature + 5ºC to 300ºC

# DBA Simulation Facility (LOCA Test Chamber)

Main equipment includes:

- An electric boiler for saturated steam supply (66 kW power, 0,24 m3 volume, operating pressure 9 barg, operating temperature 180 ºC)

- A LOCA test chamber where the test specimens are set (length 1742 mm, diameter 1016 mm, ASME stamp 10 barg MAWP)



# CAREM 25

- https://inis.iaea.org/collection/NCLCollectionStore/_Public/32/068/32068427.pdf?r=1&r=1
- https://www.youtube.com/channel/UC8uv1jtMYYrbLiAut1ChS9A

# CAREM Coatings qualification

Qualification according to ASTM D 5144 – “Standard Guide for Use of Protective Coating Stds in Nuclear Power Plants”

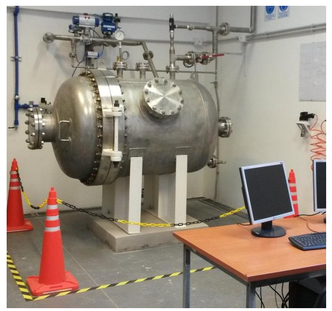
ASTM D 3911 – “Evaluating Coatings Used in Light Water NPP at Simulated Design Basis Accident (DBA) Conditions”

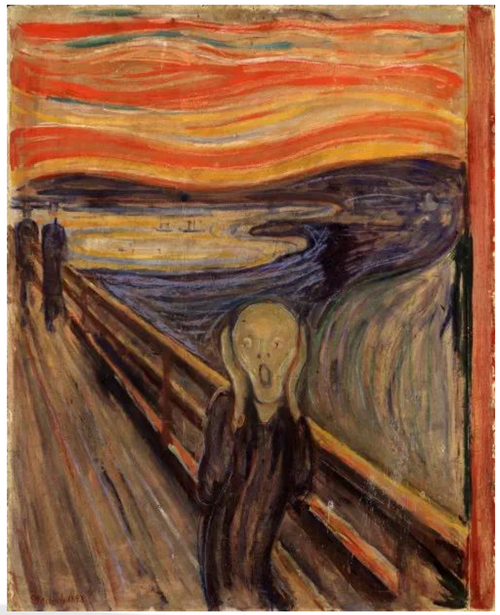
1 2

3 4

DBA + service life dose

Test coatings with applicable t-T-P curves simulating DBA atmosphere





**Thermal Aging?**
**Water?**

# Challenges

- How does submergence in water affect ageing?
- How to calculate Activation Energy for a coating? DSC, TGA is performed in air… how can we simulate underwater degradation?
- Proposal from CNEA: Introduce sample deposit such as cable deposit/RPV surveillance program in order to assess real condition of coating→ Visual inspection and Adhesion test as a main CM technique.

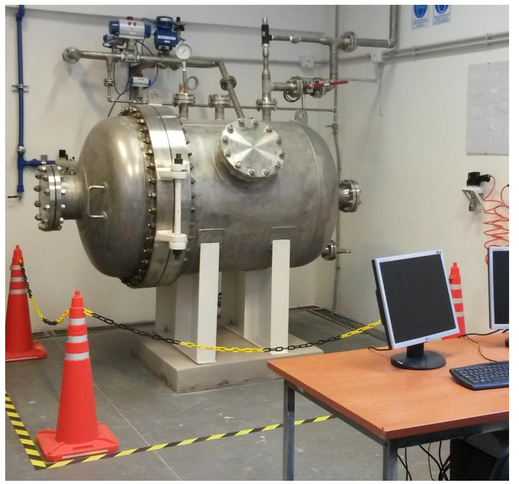
# CAREM Coatings qualification

Our general approach:

1 2 → Test coatings with applicable t-T-P curves simulating DBA atmosphere

3 4 → Thermally aged in oven (air) → Adhesion test → DBA dose →

5 6 → Thermally aged in water (submerged) → Adhesion test → DBA dose →



Adhesion test

# CAREM Coatings qualification

| Probe type | Undamaged | Damaged and Repaired | Aged in air | Aged in water |
|---|---|---|---|---|
| A | ✓ | | -- | -- |
| B | | ✓ | -- | -- |
| C | ✓ | | 5 years | |
| D | | ✓ | 5 years | |
| E | ✓ | | | 5 years |
| F | | ✓ | | 5 years |
| G | ✓ | | 10 years | |
| H | | ✓ | 10 years | |
| I | ✓ | | | 10 years |
| J | | ✓ | | 10 years |
| K | ✓ | | 15 years | |
| L | | ✓ | 15 years | |
| M | ✓ | | | 15 years |
| N | | ✓ | | 15 years |

# EQ Preservation: cables of Embalse

# LTO of Embalse NPP

- The plant had a original license of operation around 30 fpy. No PSR methodology for licensing.
- The plant had no complete EQ from the initial operation.
- Life extension implied total replacement of pressure tube and Steam Generators
- Most of installed cables (made of PVC) were provided by Pirelli Argentina in a special procurement

- Agreement between operator and regulator for LTO that include several milestones such as EQ program, AMP of new and old SSC at the plant.
- PSR was established for 2nd cycle of operation.
- EQ master list, procurement of EQ component, installation and commissioning performed for 2nd cycle of operation.

# EQ Preservation: cables of Embalse

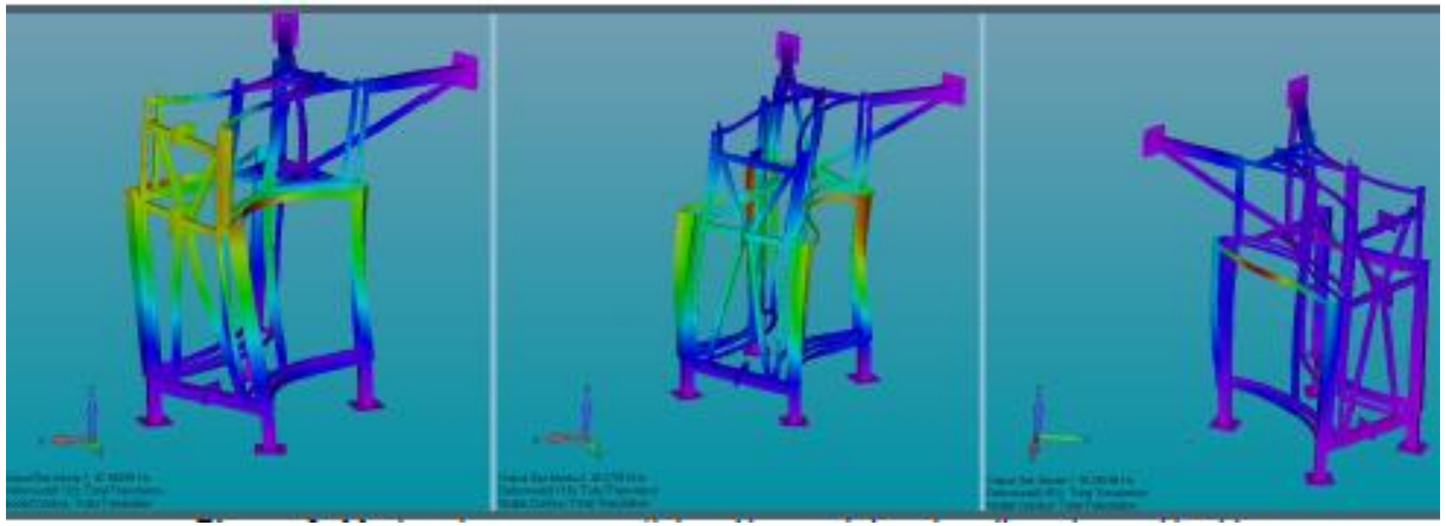
- The preservation program for EQ cables is performed as part of Cable AMP. Why?
  - Cable AMP was a specific milestone in Life extension project →very “aggressive” test plan for non EQ PVC cables.
  - Simplification of plant procedures

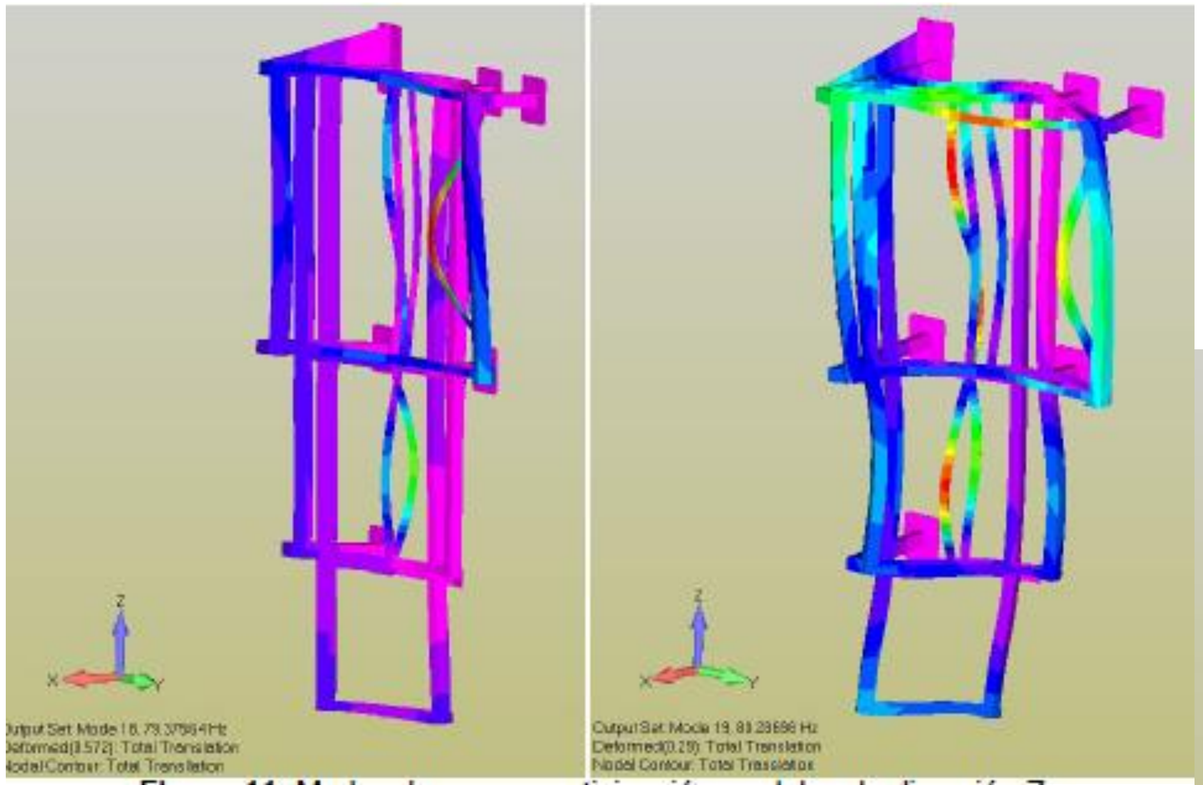
# Aging management strategy A

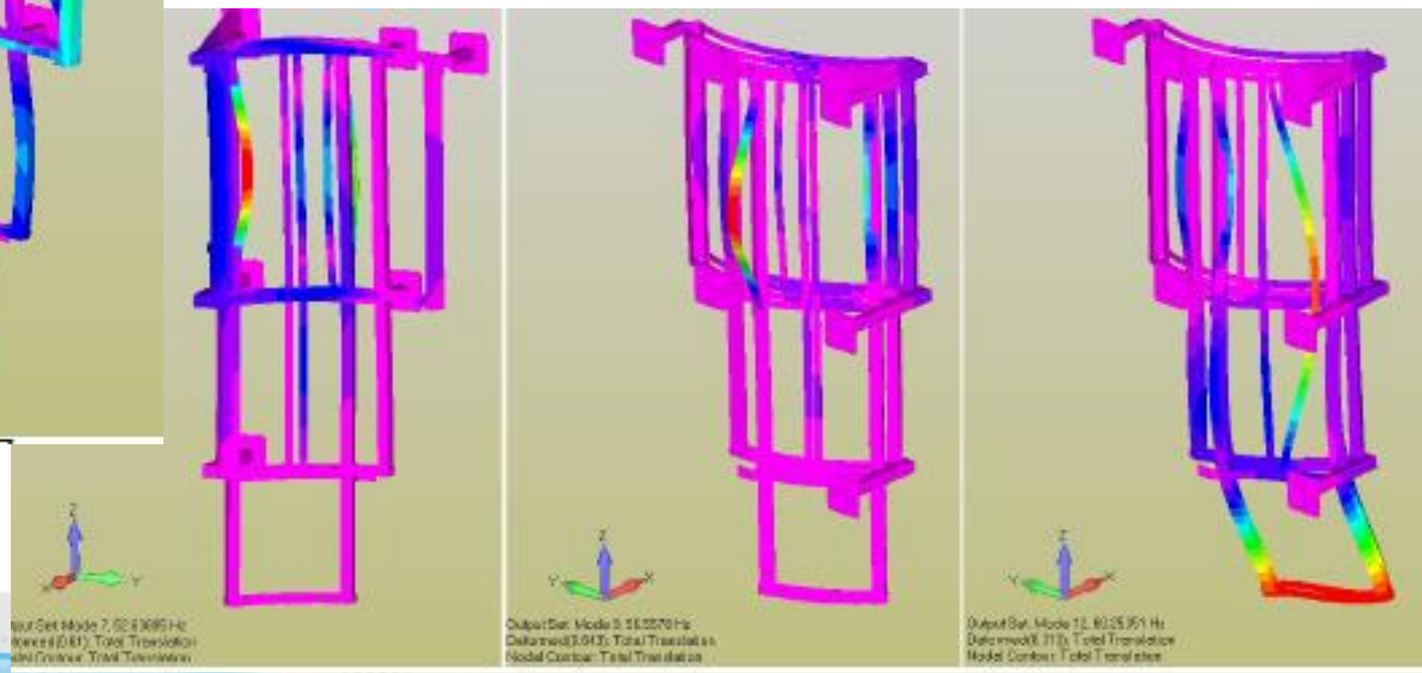
- Samples on deposits (3 location + contingency plan)
  - Accelerated ageing
  - Samples for mechanical tests
  - Samples for electrical tests (re-qualifying actions if necessary)
- Samples on cable trays
  - Current status of the cables

# Aging management strategy B

- Samples on deposits (1 location + contingency plan)
  - Accelerated ageing
  - Samples for mechanical tests
  - ~~Samples for electrical tests (re-qualifying actions)~~
- Samples on cable trays
  - Current status of cables




Output Set: Mode 18, 79.37984 Hz
Deformed(8.572): Total Translation
Nodal Contour: Total Translation
Output Set: Mode 19, 80.23696 Hz
Deformed(0.29): Total Translation
Nodal Contour: Total Translation



**Comisión Nacional de Energía atómica**

THANK YOU VERY MUCH FOR YOUR ATTENTION!!!

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