

# PLIM AND LTO AT TVO

**CORDEL - TECHNICAL AND REGULATORY ISSUES FACING  
NUCLEAR POWER PLANTS**

***LEVERAGING GLOBAL EXPERIENCE***

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# PLIM AND LTO AT TVO

Introduction

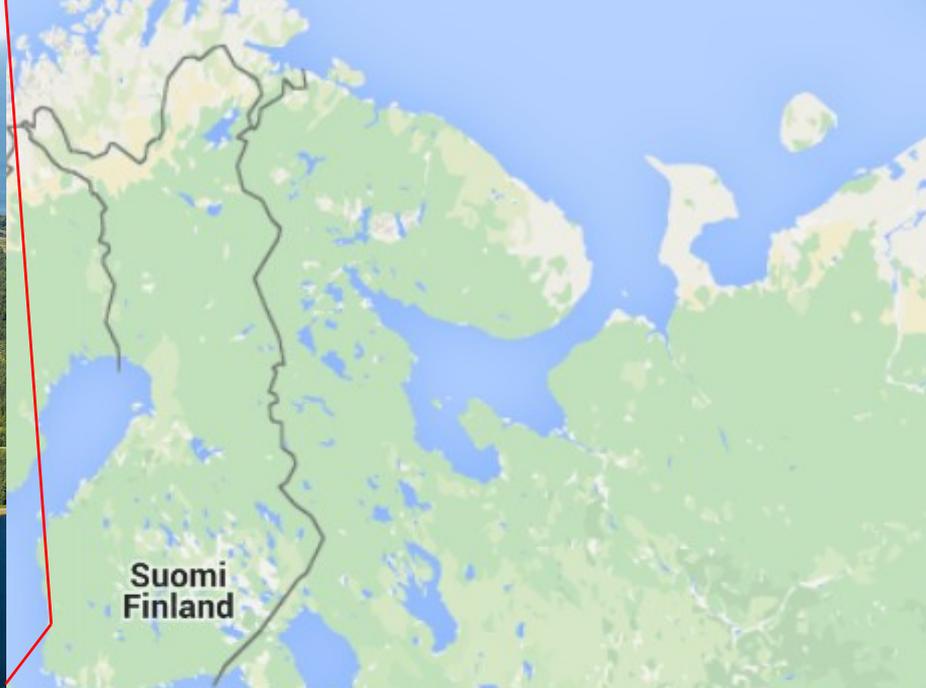
Plant modifications

TVO today

Prioritizing and timing maintenance

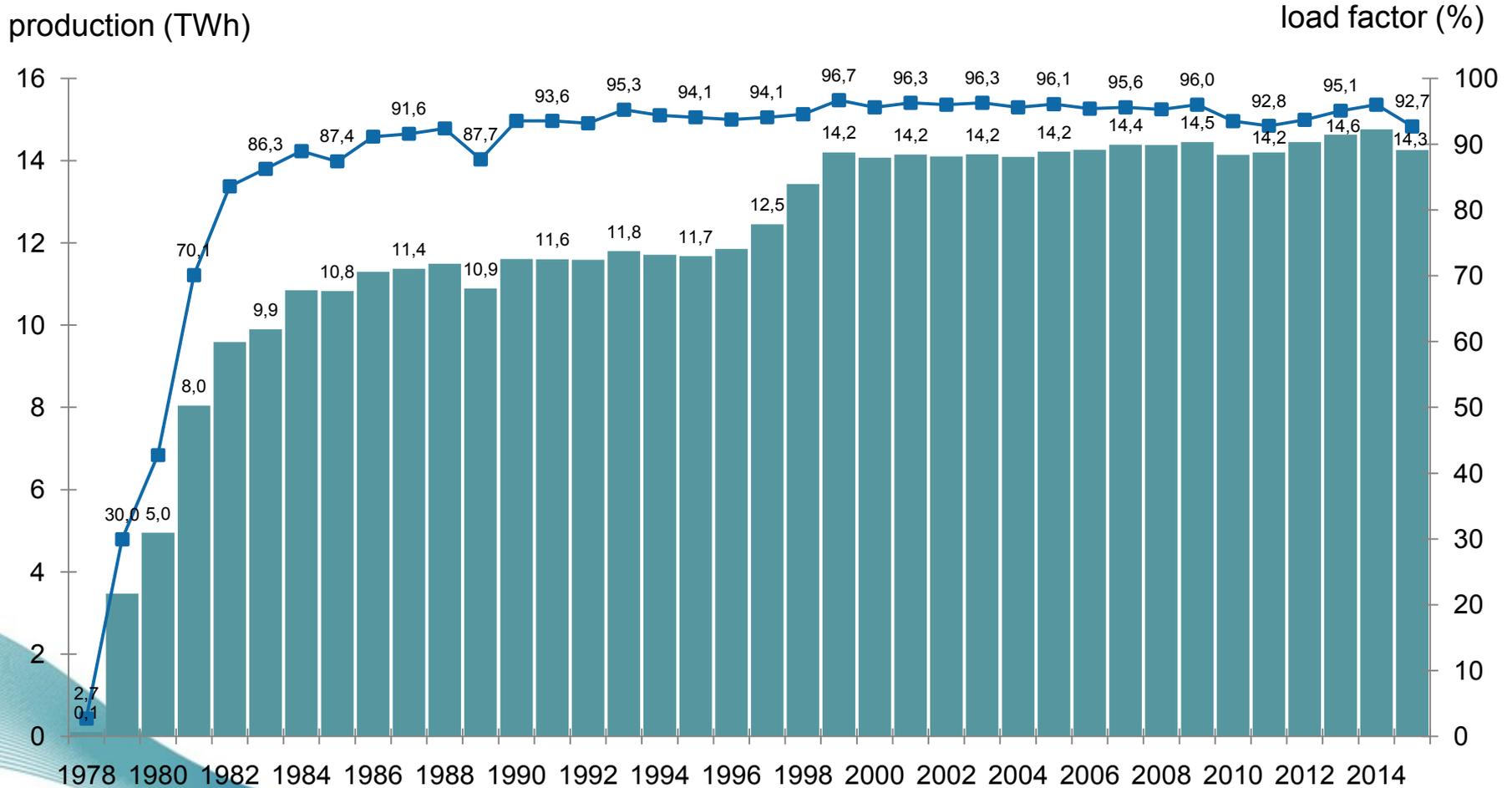
Operational Risk Management

Strategic decisions



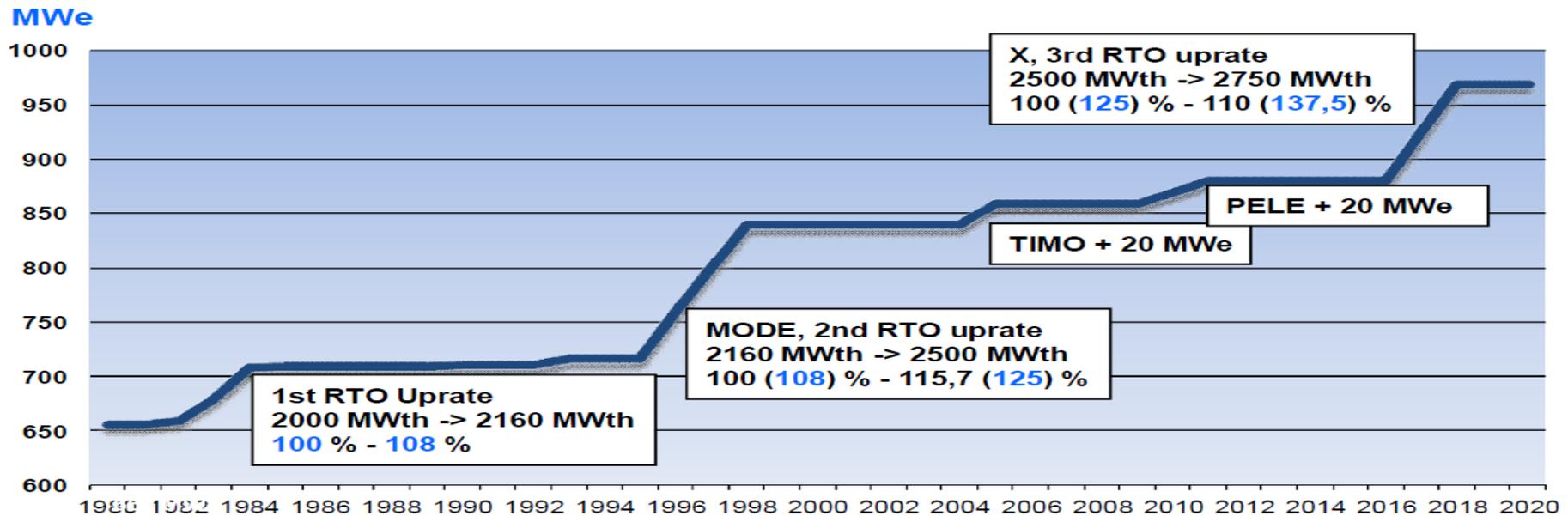


# STABLE AND RELIABLE PRODUCTION



# TVO'S PLIM STRATEGY AND POWER UPRATINGS

- Keep the units “As good as they were when new” and have “Always 40 years operation time ahead”
- TVO has uprated reactor power twice – next one planned
- Main component replacement according to Ageing Evaluation during power uprating projects
- The goal has been to maximize production and to minimize outage times

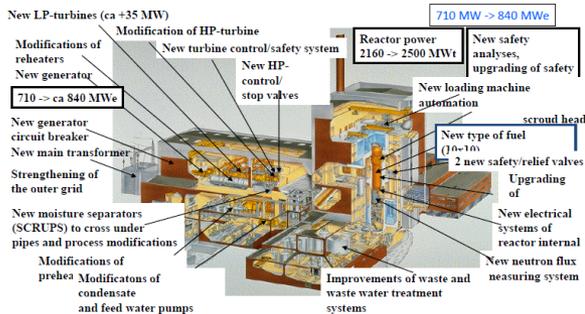


# TVO'S MARKET POSITION IN NORDIC FROM 1970'S TO 2000

- TVO produces electricity only for shareholders on cost without profit
- From 1970's to 1990's TVO produced electricity only for shareholders own use - mainly pulp and paper industry
  - ❑ Maximization of production was most important
    - High availability, stable production and power uprating
- In 1990's started opening of electricity market - shareholders also on the market
  - After that price of electricity collapsed in Nordic Countries
  - Stable production still valuable

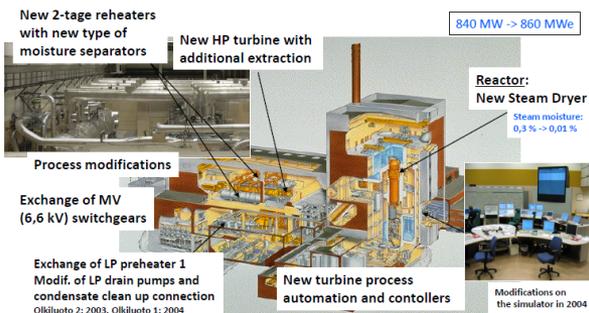
# MODERNIZATION OF OLKILUOTO UNITS 1&2

## Olkiluoto NPP – Modernization Project 1994-1998

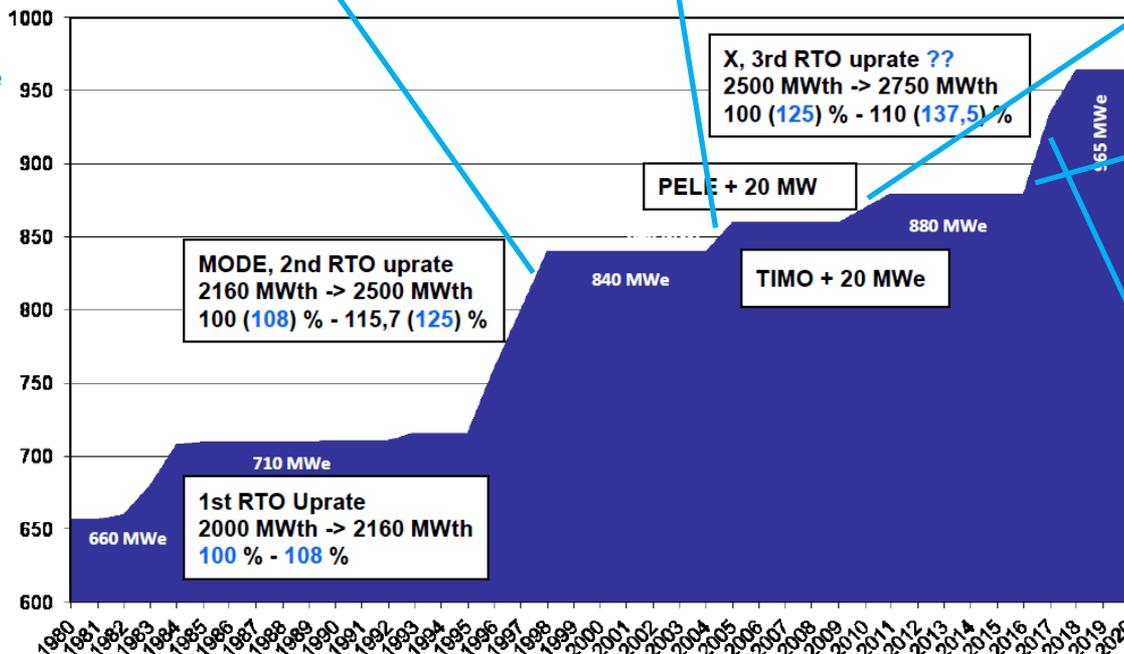
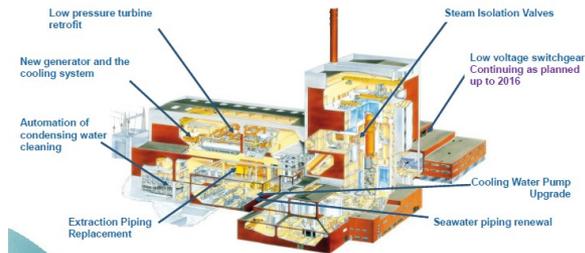


## Olkiluoto NPP – Turbine Island Modernization

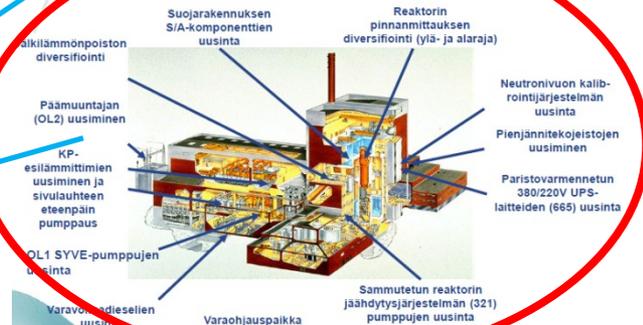
Olkiluoto 2: 2005 Olkiluoto 1: 2006



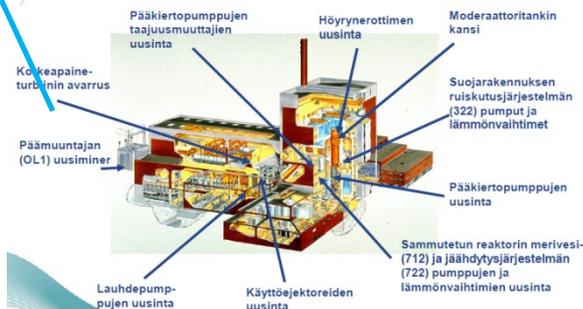
## PELE - OUTAGES 2010-2012 THE MOST EXTENSIVE OF ALL TIMES +20 MW/ UNIT



## OL1 JA OL2 2017-HANKE, PROJEKTIT



## OL1 JA OL2 TERTIÖKOROTUS (OL1 JA OL2 2017-HANKKEEN LISÄKSI), ALUSTAVA



# Olkiluoto NPP – Modernization Project 1994-1998

15 years  
old units

New LP-turbines (ca +35 MW)

710 MW -> 840 MWe

Modifications of  
reheaters  
New generator  
**710 -> ca 840 MWe**

Modification of HP-turbine  
New turbine control/safety system  
New HP-control/  
stop valves

Reactor power  
2160 -> 2500 MWt

New safety  
analyses,  
upgrading of safety

New generator  
circuit breaker  
New main transformer  
Strengthening of  
the outer grid

New loading machine  
automation

scroud head  
New type of fuel  
(10+10)  
2 new safety/relief valves

New moisture separators  
(SCRUPS) to cross under  
pipes and process modifications

Upgrading  
of  
New electrical  
systems of  
reactor internal

Modifications of  
preheaters  
Modifications of  
condensate  
and feed water pumps

Improvements of waste and  
waste water treatment  
systems

New neutron flux  
measuring system

# Olkiluoto NPP – Turbine Island Modernization

Olkiluoto 2: 2005 Olkiluoto 1: 2006

25 years  
old units

New 2-stage reheaters  
with new type of  
moisture separators

New HP turbine with  
additional extraction

840 MW -> 860 MWe

**Reactor:**  
New Steam Dryer

Steam moisture:  
0,3 % -> 0,01 %

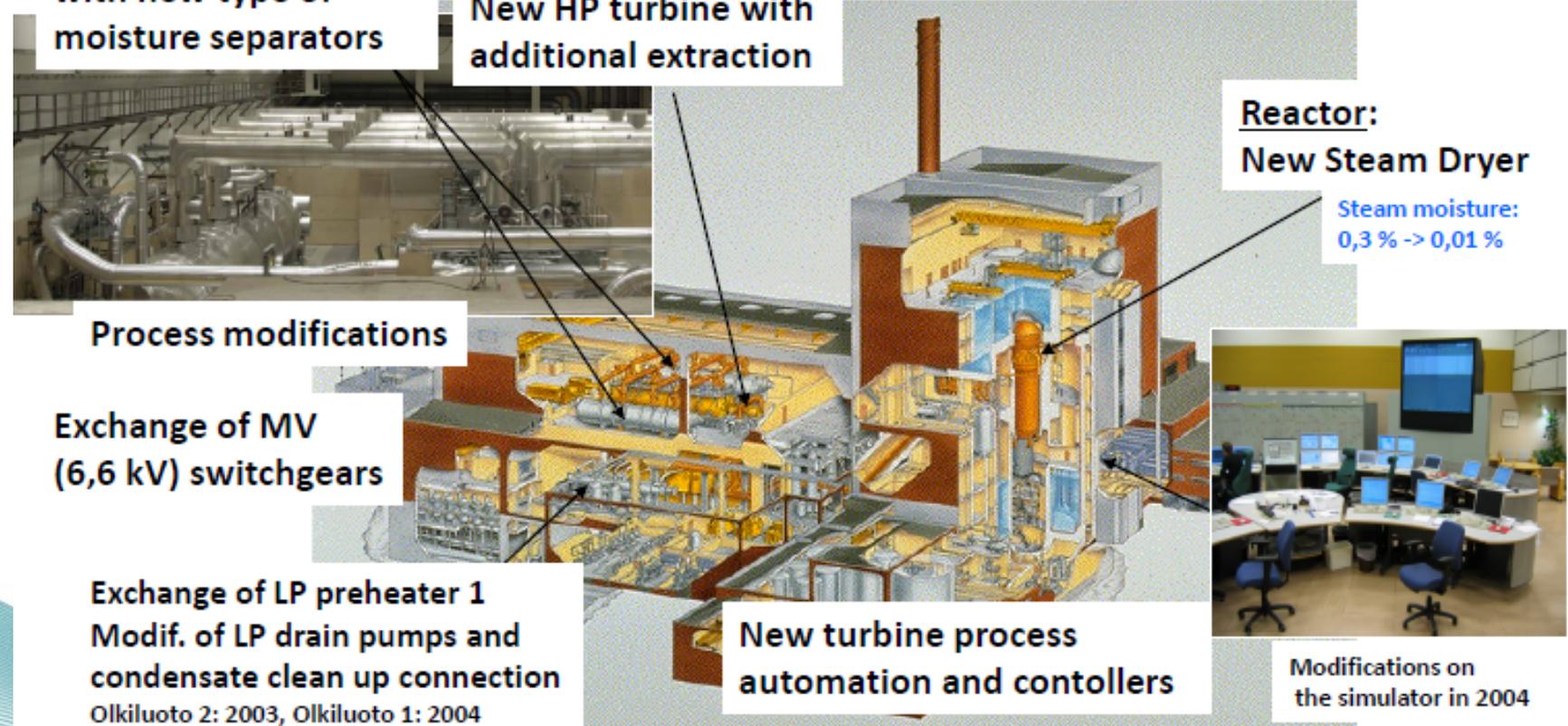
Process modifications

Exchange of MV  
(6,6 kV) switchgears

Exchange of LP preheater 1  
Modif. of LP drain pumps and  
condensate clean up connection  
Olkiluoto 2: 2003, Olkiluoto 1: 2004

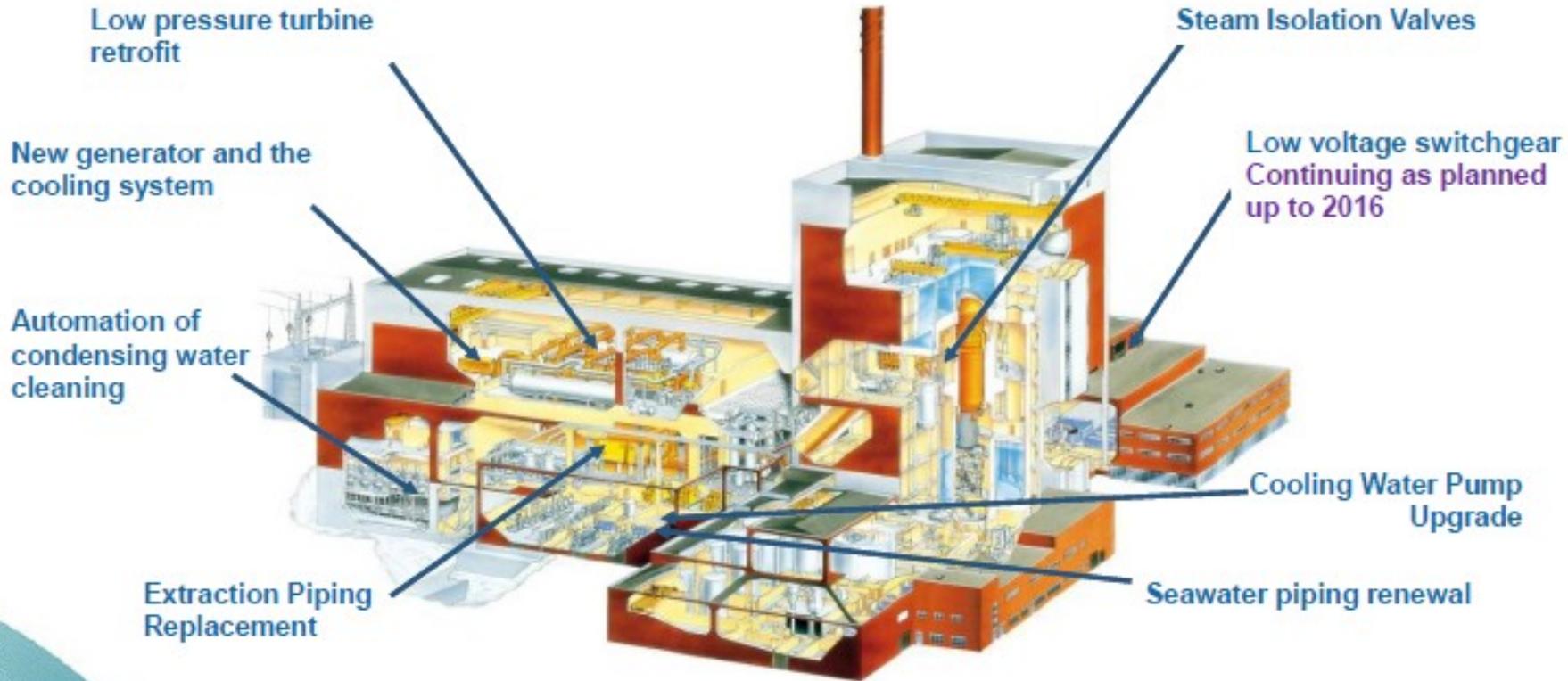
New turbine process  
automation and controllers

Modifications on  
the simulator in 2004



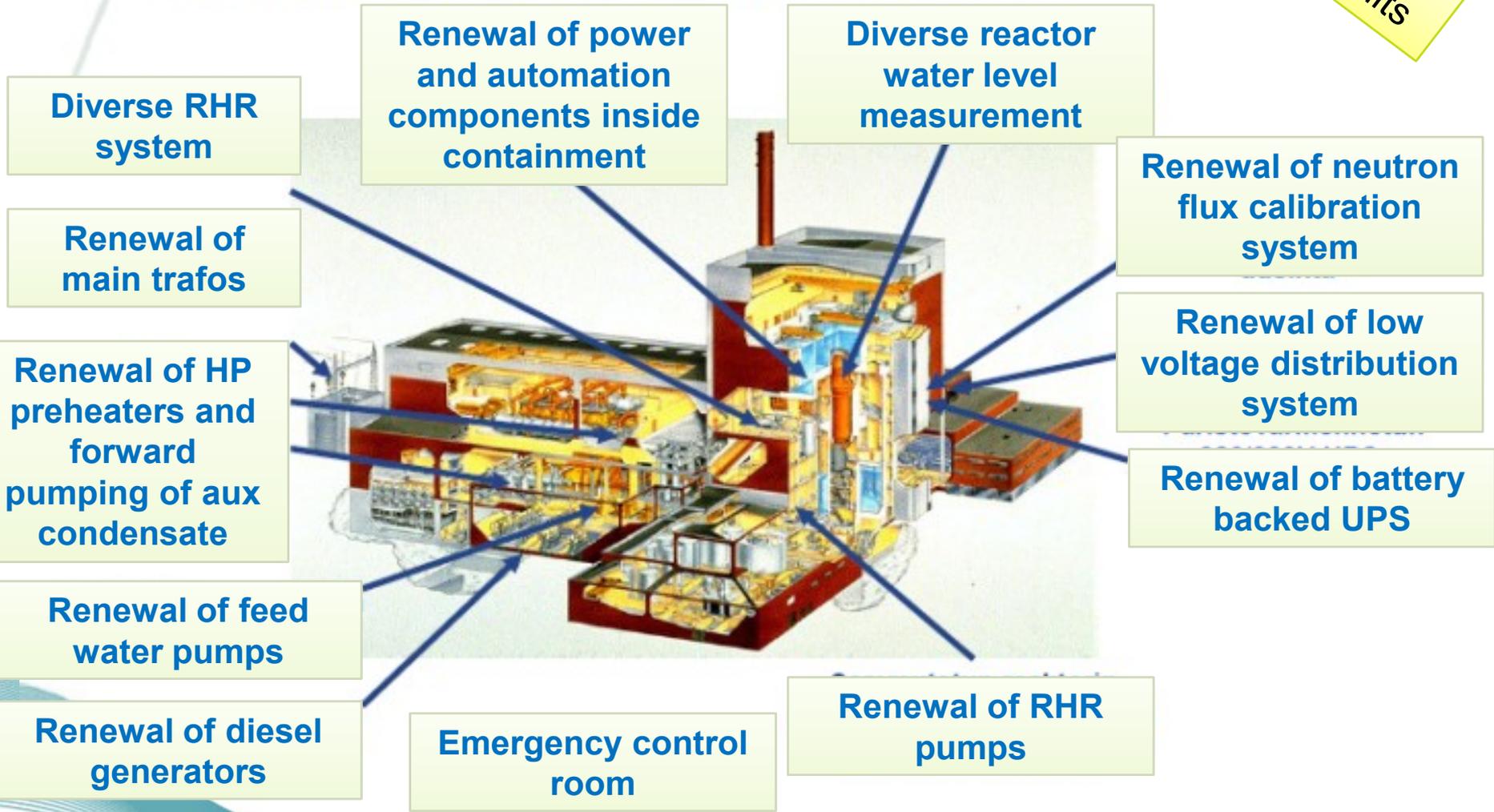
30 years  
old units

# PELE - OUTAGES 2010-2012 THE MOST EXTENSIVE OF ALL TIMES + 20 MW/ UNIT



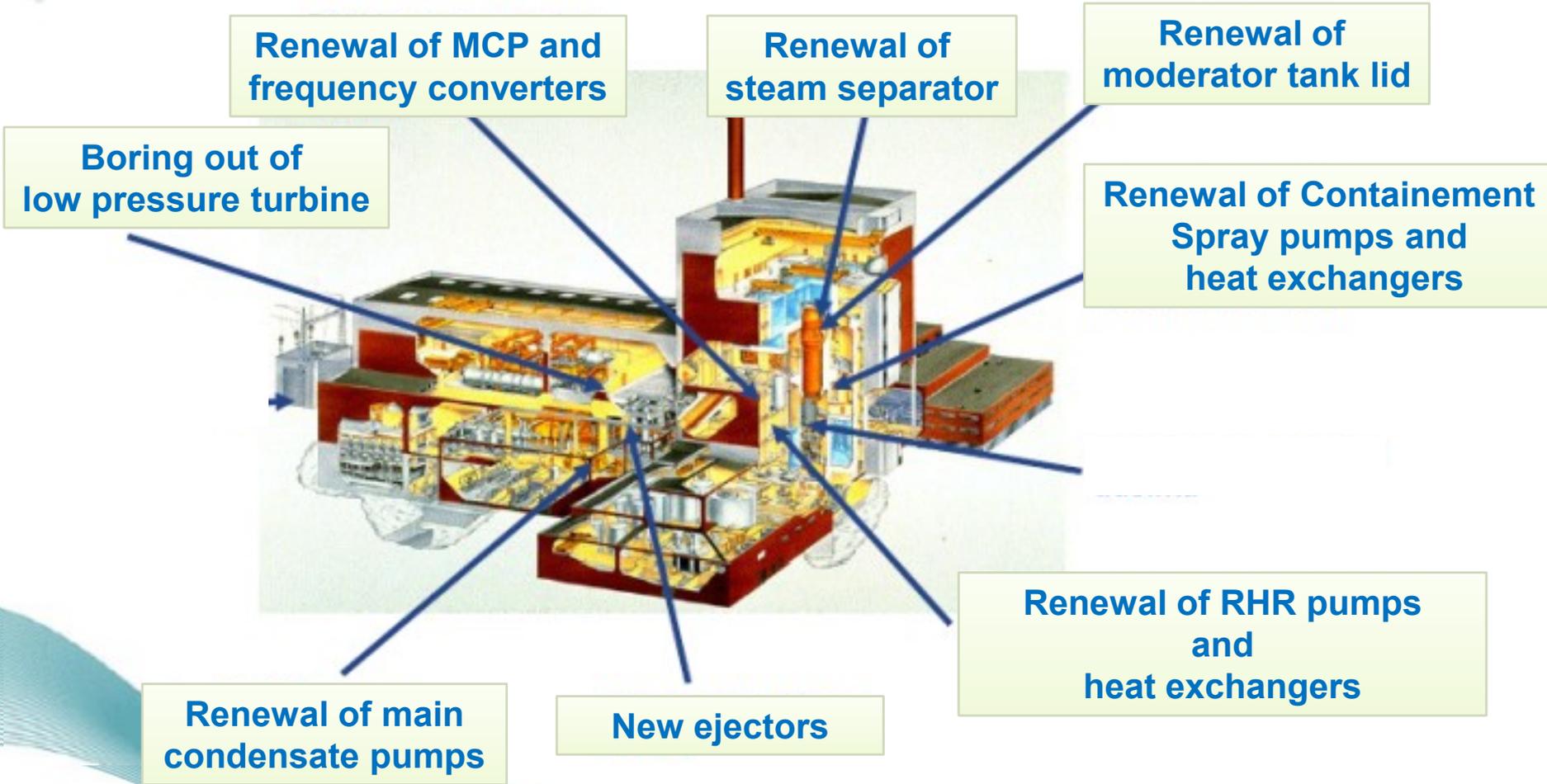
37 years  
old units

## MODERNIZATION PROJECT 2017



40 years  
old units

# POWER UPRATE IN ADDITION TO MODERNIZATION PROJECT 2017 (PRELIMINARY)

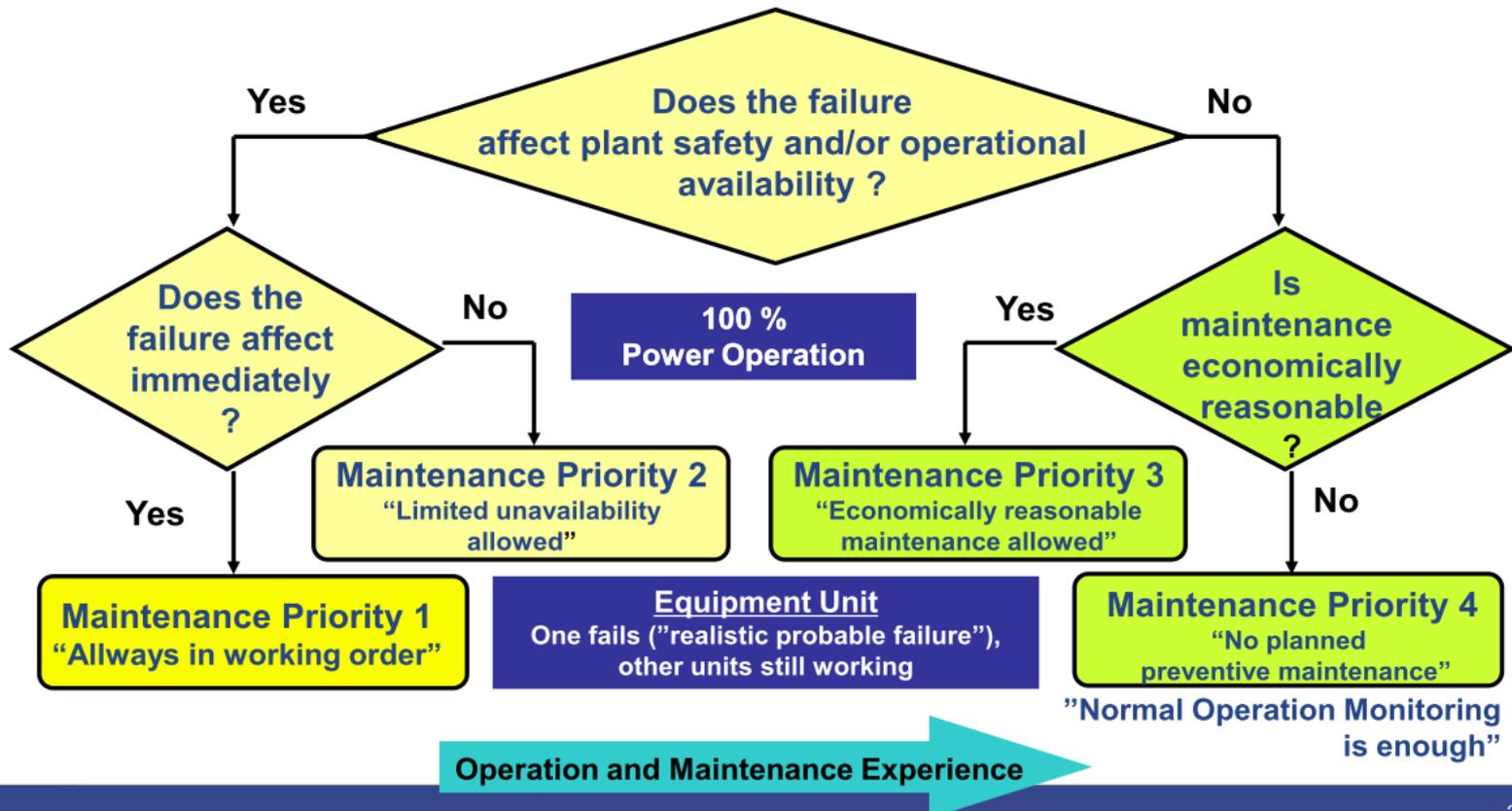


# TVO TODAY AND TOMORROW

- Today the situation for a utility is difficult
  - Market price has collapsed also in Finland and profitability is low
  - No possibilities for power up-rating
  - No possibilities for renew plants as before – no more money for investment
  - Flexibility will be more and more valuable
  - Tomorrow
    - Profitability seems not change better
    - Flexibility will be more and more important
    - PLIM and LTO more and more critical – profitability is still much better than for new investments
- This situation is totally different than it was yesterday.
- In TVO we have to learn a new way of operation and maintenance

# Olkiluoto 1 and 2 - Maintenance Analysis

## Maintenance Priority of Equipment Units



# REGULATORY REQUIREMENT

TVO's ageing management has previously concerned the whole plant. New regulatory guidance YVL A.8 (Ageing Management of Nuclear Facility) requires ageing management of nuclear safety significant SSC's.

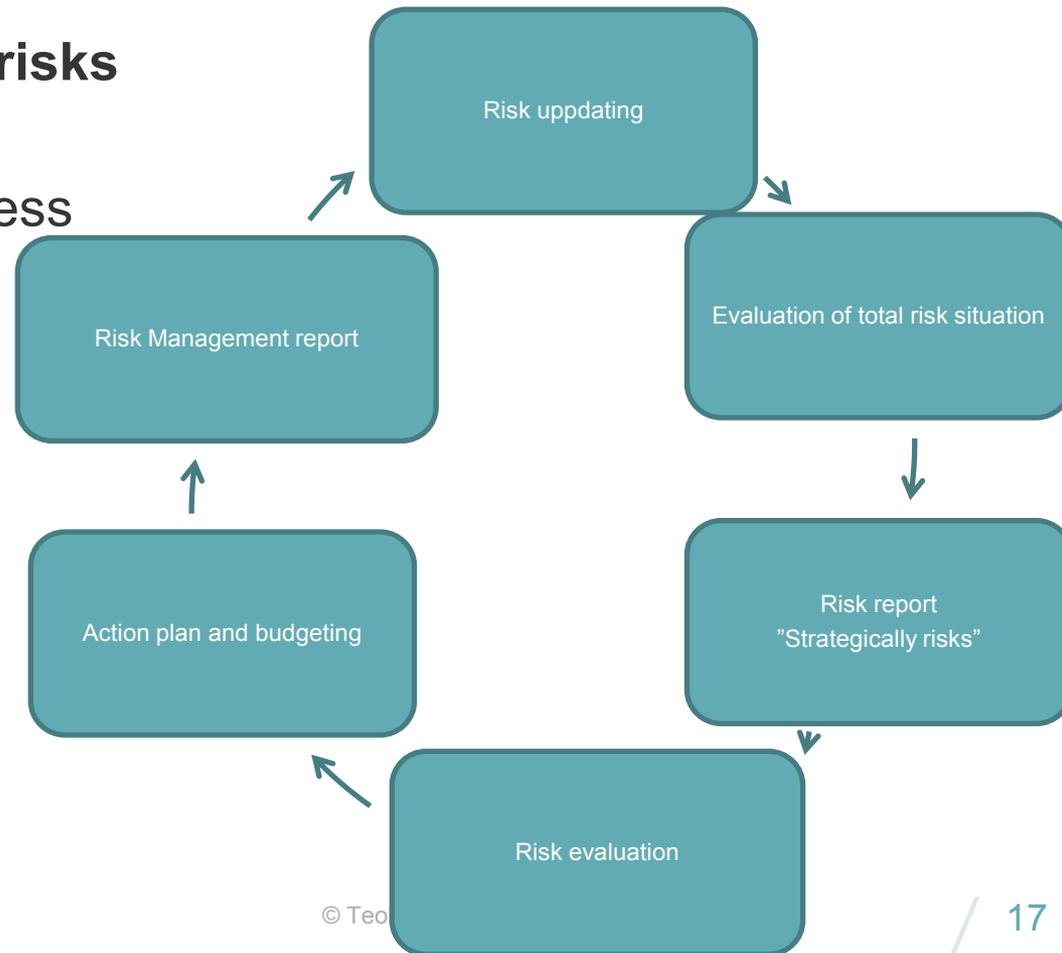
TVO will divide ageing management to focus to the safety SSC's and plant lifetime management to focus rest of the plant.

# RISK MANAGEMENT IN TVO

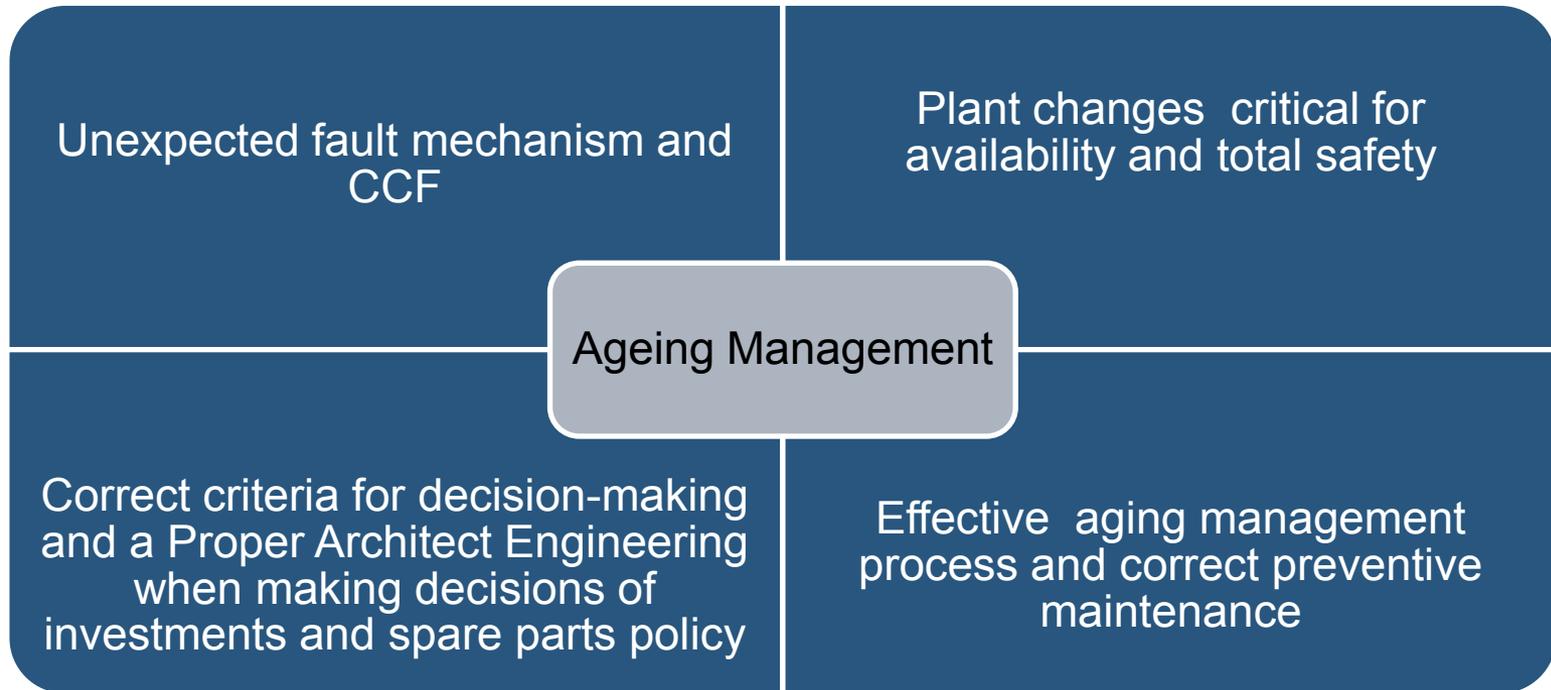
**Risk Management** according to ISO 31000 standard as a part of the strategic and operative planning and project management.

**Technical risks ja Operative risks** are evaluated during the risk assesment phases of the process

Risk management is the **responsibility of the whole organization**



# OPERATIONAL RISK MANAGEMENT IN TVO



# RISK EVALUATION

- In risk evaluation also the risks of life-time management have been prioritized
- Those risks are connected to:
  - **show stoppers**
    - Physical and technological ageing, Know-how, Politics
  - **quality and availability of information and documentation**
    - Supplier, Data base, Operation experience
  - **know-how and expertise**
  - **decision making**
    - Operative decision-making override strategic decision-making
    - Short-term savings costs long-term

# STRATEGIC DECISIONS

- Profitability is today lousy
  - More cost awareness
  - **Optimal** long term operation
- 
- Asset Management (as it is in PAS55 or ISO 55000) will get more important role in future
  - More effort will be put on Ageing Management
  - “40 years ahead” will be changed to Certain Date (still open)
  - Cost benefit analysis for all investments will be evaluated before investment decision
  - Calculations will be done over the whole lifetime
  - No unnecessary (Nice to have) investments in future

The logo consists of the letters 'TVO' in a white, bold, sans-serif font, positioned inside a dark blue circular shape. This circle is part of a larger graphic design on the left side of the slide, which includes overlapping circles in shades of blue and teal, and a series of thin, curved lines that create a sense of motion or a stylized arrow pointing towards the right.

**TVO**

**THANK YOU**