Risk-informed On-Line Maintenance at Cofrentes NPP

Workshop Information

IAEA Workshop

City, Country
XX - XX Month, Year
Objectives

– To maintain and improve safety through:
  • Negligible unavailability increase and configuration risk control due to simultaneous unavailability of systems.
  • System reliability improvement by:
    ❖ Better scheduling of tasks.
    ❖ Use of most qualified people.
    ❖ Better control of results.

– To reduce maintenance costs:
  • Better schedule → less unavailability time.
  • Reliability improve → reduction in corrective maintenance.
  • Reduction on maintenance tasks during outages.
  • Potential reduction in outage time.
Starting Point

- Traditionally, maintenance tasks done at power over systems controlled by Technical Specifications were just:
  - Corrective maintenance.
  - Surveillance testing.
  - Short maintenance tasks due to manufacturer recommendations or operating experience.

- During outages great amount of tasks.
  - High unavailability during outages. Some systems could have bigger safety importance during outage than during power operation.

- To delay some maintenance tasks gives reliability get worse.
Preventive Maintenance Definition

- A task should be considered inside this program if all these three conditions are given:
  
  - Plant is at operating Mode 1.
  
  - System, equipment or component to maintain is controlled by Technical Specifications.
  
  - Maintenance execution gives to a voluntary entry in a LCO.
Limitations

– Just one entry in each LCO.
– Just one entry each year by system.
– Preventive maintenance time: should be less than 60% of LCO limit.
– Time given by LCO should be more than 72 hours.
– No simultaneous works on more than one frontal system.
– No scheduled changes on plant operating mode during works.
Current Scope of the Program

- E12 - Residual Heat Remove System A and B.
- E12-C - Low Pressure Core Injection, train C.
- E21 - Low Pressure Core Spray.
- P38 - Standby Gas Treatment System Trains A and B.
- P54 - Essential Compressed Air A and B.
- T52 - Drywell /Containment mixing Air System.
- T27/F42 - Transferring Tube /Fuel Upper Pool.
- XG3 - Control Room HVAC, trains A and B.
- P64 - Fire Protection System.
- E32 - Main Steam Isolation Valves Leakage Control System.

- In the near future:
  - R43 - Diesel Generators.
Feasibility Study

- Scope (for each system):
  - Tech specs affected.
  - Safety functions affected.
  - Deterministic and probabilistic (PSA) assessment of associated unavailability.
  - Alternative systems to fulfil safety function(s) affected. Operability requirements.
  - Simultaneous system unoperabilities forbidden, because of tech specs or because of causing high risk.
  - Confirmation that trip probability is not increased, and review of ALARA criteria.
Risk Limits of the Program

- The risk limits are obtained from RG 1.174 and NUMARC 93-01.
- RG 1.174 gives the limits in the general implementation of the program.

ΔCDF

Region I - Forbidden change

Region II - Look for accumulated changes

Region III - Change should be accepted

1E-05 1E-04 CDF
Risk Limits of the Program (II)

- NUMARC 93-01 gives the limit that apply to a specific configuration.
- None configuration should produce CDF greater than $1E^{-3}$/year.
- For any entry in the program, DCDP should be:

<table>
<thead>
<tr>
<th>$\Delta$CDP</th>
<th>Considerations</th>
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<tbody>
<tr>
<td>$&gt;1E^{-05}$</td>
<td>Do not enter voluntarily</td>
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<tr>
<td>$1E^{-6}$ –</td>
<td></td>
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<tr>
<td>$1E^{-5}$</td>
<td>- Assess not quantifiable factors</td>
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<tr>
<td></td>
<td>- Establish Risk Management Actions</td>
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<tr>
<td>$&lt;1E^{-6}$</td>
<td>Normal Work Controls</td>
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Execution Procedure

– An specific plant procedure has been developed for the execution of on-line maintenance, in order to guarantee:

  • Responsibilities.
  • Feasibility study existence.
  • Plant configuration analysed (pre-requirements of operability of systems are fulfilled).
  • Compensatory measures, if have been defined, has been taken.
  • Task schedule is detailed and feasible. Spare parts are available and training have been done.
  • It is not expected a change in the operating mode.
Risk Monitor

- A risk monitor based on PSA models analyse scheduled works (maintenance): temporary risk.
- It is also used when clearance are authorised (use by operators), because the case that plant situation is not the expected.
Training to Maintenance People

- Before the execution of the tasks people involved are trained, including:
  - Function(s) of the system.
  - Safety importance of the system, Technical Specifications and PSA.
  - Importance of the works in plant objectives.
  - Responsibility of the tasks.
Results of the Program (1/2)

- Program makes operators and schedulers work together with PSA, giving everybody a global vision of the problems associated with the running of the plant.

- Risk concept is introduced in the organisation, improving safety culture.

- Pre-working training gives a better people motivation, adding responsibility and involving in plant objectives.
Results of the Program (2/2)

- Detailed schedule of tasks gives that all organisations are involved in the execution of the tasks, comparing with a higher distribution during outages.
- Moving works from outages gives safer and more simple outages.
- Tasks are done in less time and with more efficiency by own personnel.
- Due to a better global maintenance, reliability is improved and so safety.