Managing Year 2000 at a VVER-Plant - A Case Study from Loviisa NPS

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Contents of the presentation

Loviisa NPS

Company Millennium project

Loviisa NPS Y2k project

- Project plan
- Testing and validation
- Results
- Remediation

Contingency Planning

- Electric grid

Loviisa NPS

- Two unit PWR (2 x 510 MW)
- In use since 1977 (Lo1) and 1981 (Lo2)
- Combination of Western and Eastern technologies
- Reactor and turbogenerators from Russia
- I&C and plant protection from Siemens/KWU
- Designed to meet Finnish requirements
- Extensive process information systems
- High load factors (~85%), short outages and low releases

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Millennium project

The Start

In some areas (e.g. IT) the work had been going on for 2 - 3 years

Late 1997

- One month risk assessment study revealed the scope of Y2K
- Alarming signals came also from USA (EPRI)
- Management took the problem very seriously and the problem got top priority
- The Millennium project was set up

Millennium project

The Scope

Inventory, analysis, testing and remedial work on systems and services used or supplied to customers

Outside dependencies

Contingency planning and crisis management

All businesses, subsidiaries, associated companies

Awareness, communication and legal aspects

Priority setting: power system high, nuclear power highest

The goal: December 1998 for most system

Millennium project

Organisation

Decentralised and centralised approach

Small centralised team

- project manager
- a few part timers and consultants

Strong steering group

- high level members from lines of business

General principle ”Trust but verify” (V. I. Lenin, 1908)

Millennium project

Responsibilities

The business units are responsible for systems and services which they use/are dependent of or which they have supplied.

Extra resources, extra expertise on a client/supplier principle from the resource pool:

- IVO Power Enqineering
- IVO Technology Center
- IVO Generation Services
- External resources

Millennium project

The Resource Pool an Roles

IVO Power Engineering

- main contractor

IVO Technology Center

- expertise on embedded systems
- responsible for the development of testing methods for embedded system
- follow up of activities e.g. EPRI

IVO Generation Services and Loviisa NPS

- expertise on how to operate and maintain the power plants
- local teams in power plants

Millennium project

Centralised Millennium Project

- The main role is to support the work done in the lines of business
- Organises support functions (legal questions, information/awareness, IT functions, networks)
- The support functions produce common procedures and models
- Is responsible of the common IT infrastructure
- Co-ordinates the effort and reports to the management

"IVO MILLENNIUM" ORGANISATION 21.12.1997

BUSINESS UNITS ARE RESPONSIBLE FOR MILLENNIUM SOLUTIONS

IVO BOARD

LO | UNIT | UNIT | UNIT | UNIT | UNIT

DIVISION | DIVISION | DIVISION | Other companies

RESPONSIBILITIES

- Systems delivered to customers
- Own power plants
- New millennium customers

Automation systems
Process information systems
Embedded systems
Separate devices, instruments etc
Administrative systems
Other systems

RESOURCE POOL

IVO PE
Tech. Center
IVO Service
IT Function
Consultant
External know-how providers
IT systems providers
Equipment providers

Date managers of companies / divisions

IVO-MILLENNIUM PROJECT GIVES SUPPORT TO COMPANIES / DIVISIONS

Project group | Support functions

Communication
Agreements, insurance
Technical support

Corporate Date manager

Steering group

IVO GROUP

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Loviisa NPS Y2K project

The Organisation

Two parallel projects

- Basic Y2k project (electronics and IS compatibility)
- Contingency planning
- Good co-operation and information change with the project for conventional power plants

Main contractors

- Resource pool (Power Engineering, Technology Centre)

Project plan

Awareness

Assessment

- Inventory
- Testing

Remediation

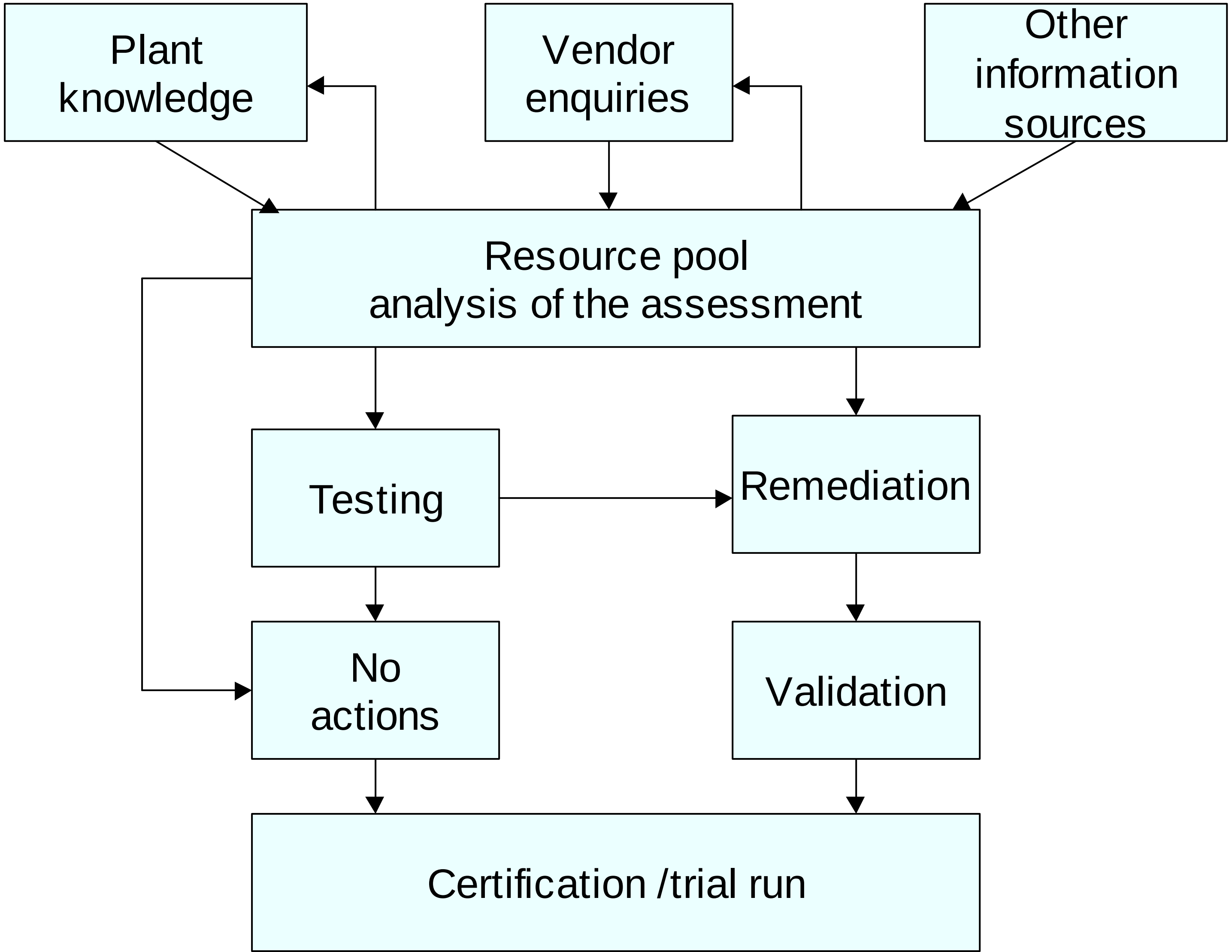
Validation

Contingency planning

IVO GROUP

Loviisa NPS Y2K project

Loviisa Power Plant



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Loviisa NPS Y2K project

Inventory:

•process automation

•electrical automation

•building automation

•telecommunications

•a hydro power plant

•gas turbines

•IT -systems

Methods:

•Review of technical documentation

•System walk downs

•Survey the vendors for information

Questions:

Are all digital devices and systems included in the inventory?

Have all devices and systems including an RTC and date data handling been recognised?

Inventory made by different persons in several cycles to get a good coverage. Inventory will go on until year 2000!

Loviisa NPS Y2K project

Prioritisation:

1. Failure in the component will cause danger to personal safety or damage to equipment
2. Failure in the component will immediately affect production
3. Failure in the component will have a delayed effect on production
4. Requirement in Technical Specifications or affect the availability of safety systems
5. The component is important for the operation or supervision of a process
6. Non-essential

Loviisa NPS Y2K project

Identification of the existence of internal clocks, analysis of year 2000 compliance.

- Plant knowledge
- Survey of vendors: letter to all vendors asking for information on their equipment. Problems:
  - Most queries remained unanswered!
  - Some suppliers/manufacturers are not there any more!
  - Are all digital devices and systems included in the enquiries?
  - Have all vendors given a satisfactory answer (certificate, test report)?
- Collecting of experiences from other power plants

Assessment is an iterative process, that will go on until and even after year 2000
Important to use multiple sources of information

Loviisa NPS Y2K project

Testing and validation

- All devices and systems using date data should be tested!
- Extensive testing during refuelling outage 1998
- Generic test procedures for unit testing (single application, software module or component)
    - 30 steps, several critical date values are tested
- System testing, all hardware and software components in a system are tested together
- Experiences from integrated plant testing at conventional power plants also used

Important in testing is to identify:
If the system transmits/receives date data to/from another system
How the date data flows in the system

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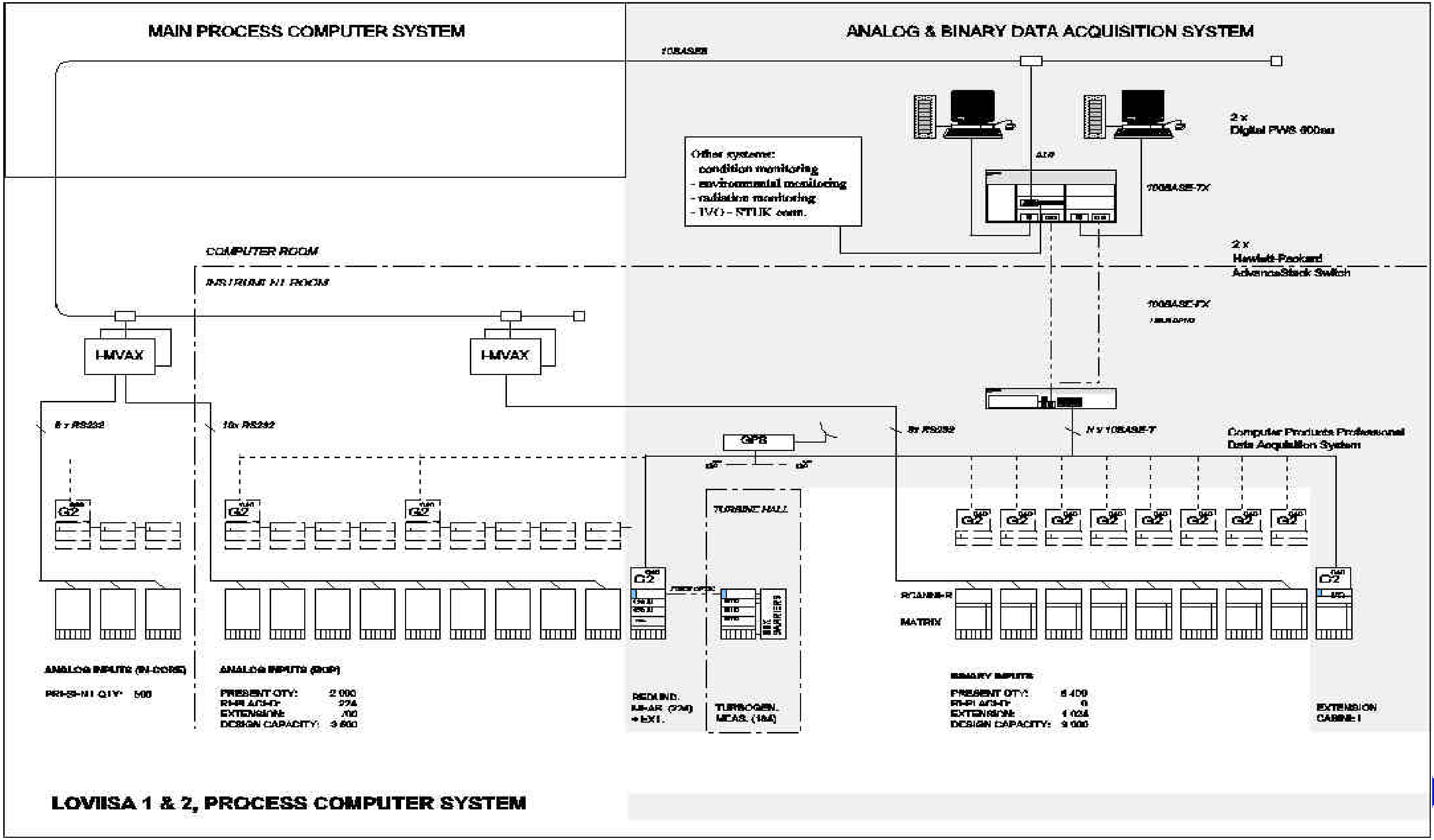
Loviisa NPS Y2K project

Process information system (PPC) testing

- Integrated system testing:
  - main computers, data acquisition, man-machine interface, network, outside links, workstations, interfaces…
  - duration of test: 9 days
  - effort:

effort:	- planning	50 man hours
	- preparation	40 man hours
	- testing	320 man hours
	- recovering	40 man hours
Total		450 man hours

Loviisa NPS Y2K project



Loviisa NPS Y2K project

Process information system (PPC) testing

- Performed tests:
  - date transitions: 31.12.1998, 9.9.1999, 31.12.1999, 29.2.2000, 31.12.2000
  - switching systems off and on (cold boot)
  - compiling and linking all application programs
  - application maintenance e.g.upgrading of process formats
  - effect of changing time (simulating daylight savings time)
- During tests monitoring of: normal operation, outputs, alarm lists, reports, cyclic events, system performance

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Loviisa NPS Y2K project

PPC testing: Example of a Test Plan

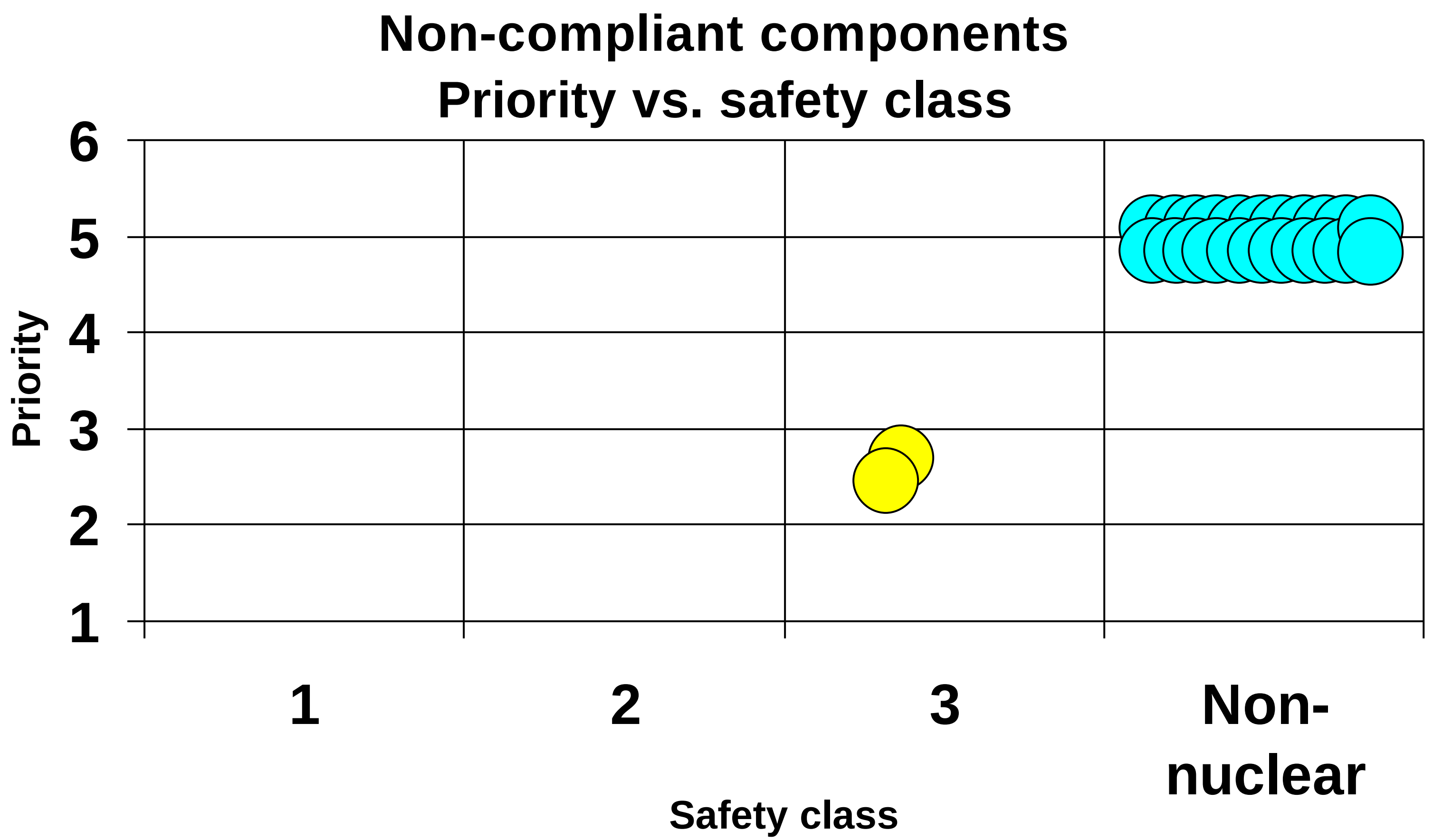
1. Introduction
2. Test Phases
3. Definitions for Test
4. Transition moment at 31.12.1998 24:00
    - 4.1 Starting time
    - 4.2 Catching Period
    - 4.3 Pre Checking Period
    - 4.4 Transition Moment
    - 4.5 Post Checking Period
5. Transition moment at 8.9.1999 24:00
6. Transition moment at 31.12.1999 24:00
    - 6.1 Starting time
    - 6.2 Catching Period
    - 6.3 Pre Checking Period
    - 6.4 Transition Moment
    - 6.5 Post Checking Period
    - 6.6 Shutdown/startup
    - 6.7 Short System Break
    - 6.8 Tools, compiling, linking
    - 6.9 Tape initialise, back up, restore
7. Transition moment at 29.02.1999 24:00
8. Transition moment at 31.12.1999 24:00

Loviisa NPS Y2K project

I&C Systems compliance

	Amount
Total amount of embedded components	215
No RTC	95
RTC and year 2000 compliant	96
Not compliant	24

Loviisa NPS Y2K project



Loviisa NPS Y2K project

Y2k Results

- Only few problems have been detected in embedded system contrary to what was expected
- The findings do not affect safety or production
- No problem in original VVER - delivery
- Some problems in later upgrades to I&C systems

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Loviisa NPS Y2K project

List of most important non-compliant components:

- telephone exchanges
- environment radiation monitoring system
- dosimetry system
- body contamination monitors
- low level waste repository cave automation system
- sewage water purification plant automation system
- steam line activity measurement system

Loviisa NPS Y2K project

Remediation

- includes all activities to make an item Y2K compliant
- decision whether to fix, replace or eliminate is made in the line organisation at Loviisa NPS
- normal maintenance and QA - procedures are used

Resources needed for assessment, remediation and validation:

- < 10 man years
- investments in new equipment < $US 2 M

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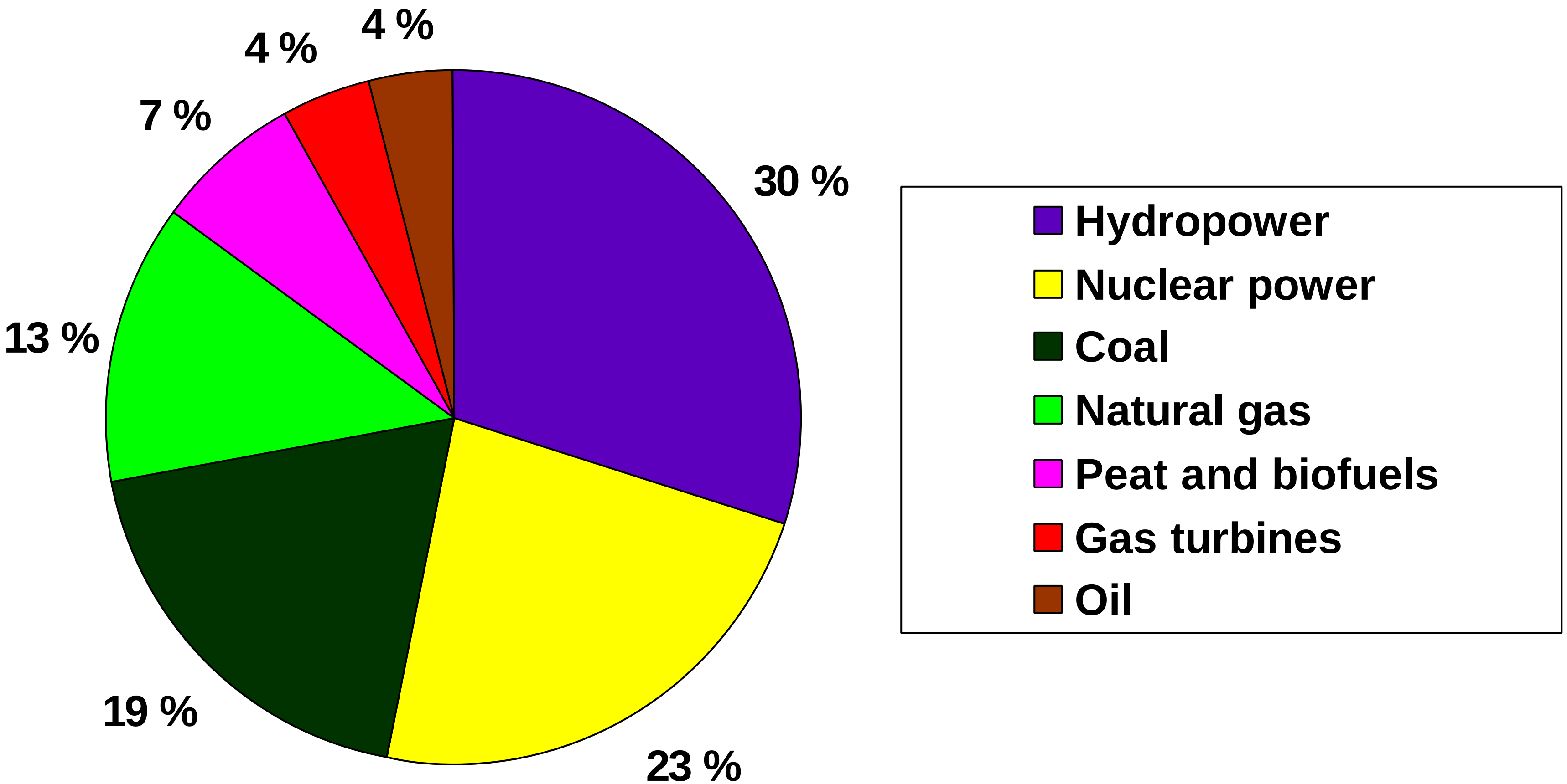
Contingency planning

Loviisa Power Plant

Power production capacity



Contingency planning

The Situation in Finland

Power Market is fully deregulated in Finland

Power balance responsibility in Finland

- Primarily all parties are responsible of their own balance
- Fingrid (= the Finnsh grid company) is by Finnish law responsible on the national level
- Co-operation by Nordic grid companies

Year 2000 co-operation in the power industry

- In Finland organised by Finergy

Contingency planning

There are interties with

Russia

- two 400 kV DC lines

Sweden

- two 400 kV lines
- one 400 kV DC submarine cable

Norway

- one 220 kV line

Time differences (Russia -1 h, Scandinavia +1 h) allow some mutual backing up.

Contingency planning

Scenario

- temperature - 25 °C
- hydropower reserves are low
- simultaneous big generating unit drop-outs
- telecommunication network is overloaded

Contingency planning

Goals are to:

- Maintain the power balance
- Keep the power production facilities safe
- Prevent damages to power production facilities
- Enable fast response and mitigation even in the worst predictable cases

Contingency planning

- A list of all generation units was drawn up (with all pertinent to Y2K features)
- For each unit its dependencies were identified, e.g.
  - National power grid
  - Clean water supply
  - Communications
  - Logistics, fuel transport
  - Station service requirements
  - Regional alarm centre, fire brigade
  - Emergency power

Contingency planning

Analysis

- Analysis of external dependencies
- What-if scenarios (deterministic)
- Process analysis (in-depth) piloted in some power plants
  - Anticipated Operational Occurrences
  - Single failures, multiple common cause failures
- Mitigation strategies for each plant type and plant

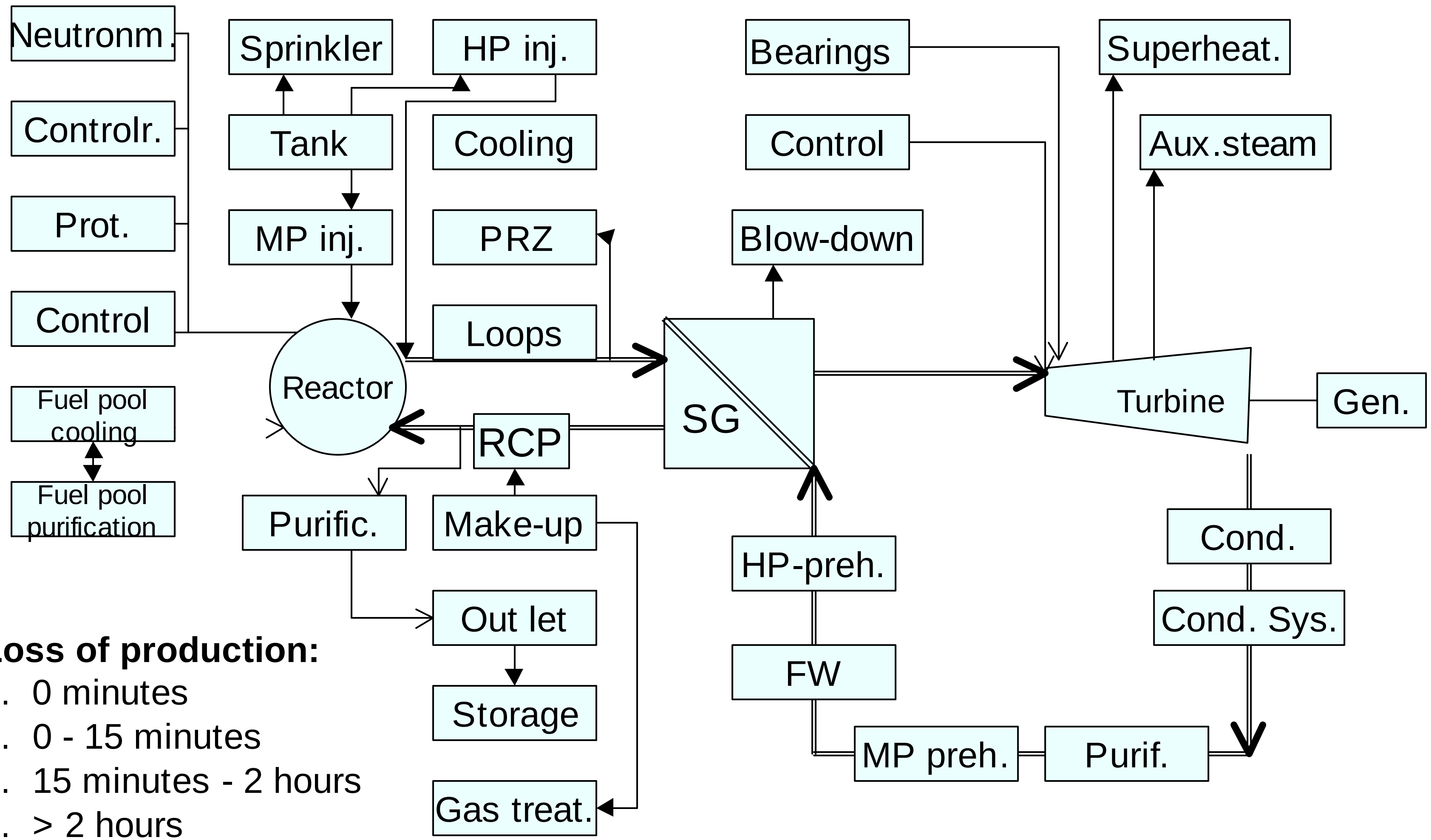
Contingency planning

Power plant critical processes, effect on power production

Assessment / remediation project		Contingency planning
Electronics	Processes	External conditions
Embedded processors Inventory Testing Remediation Validation Clean Housekeeping	Identification of critical processes Four categories: 1. Loss of production 0 min 2. Loss of production 0 – 15 min 3. Loss of production 15 min – 2 h 4. Loss of production > 2 h	Grid Station service Fuel, logistics Extra manpower Communications
Procedures, training, testing of procedures		

Contingency planning

Process analysis



Loss of production:

1. 0 minutes
2. 0 - 15 minutes
3. 15 minutes - 2 hours
4. > 2 hours

Contingency planning

All power plant types:

- Maximum available power to the grid was determined for each power plant
- Optimum mode for plant operation was analysed
- Extra manpower
- Fuel reserves
- Communication risks covered by alternative networks

Contingency planning

Loviisa NPS

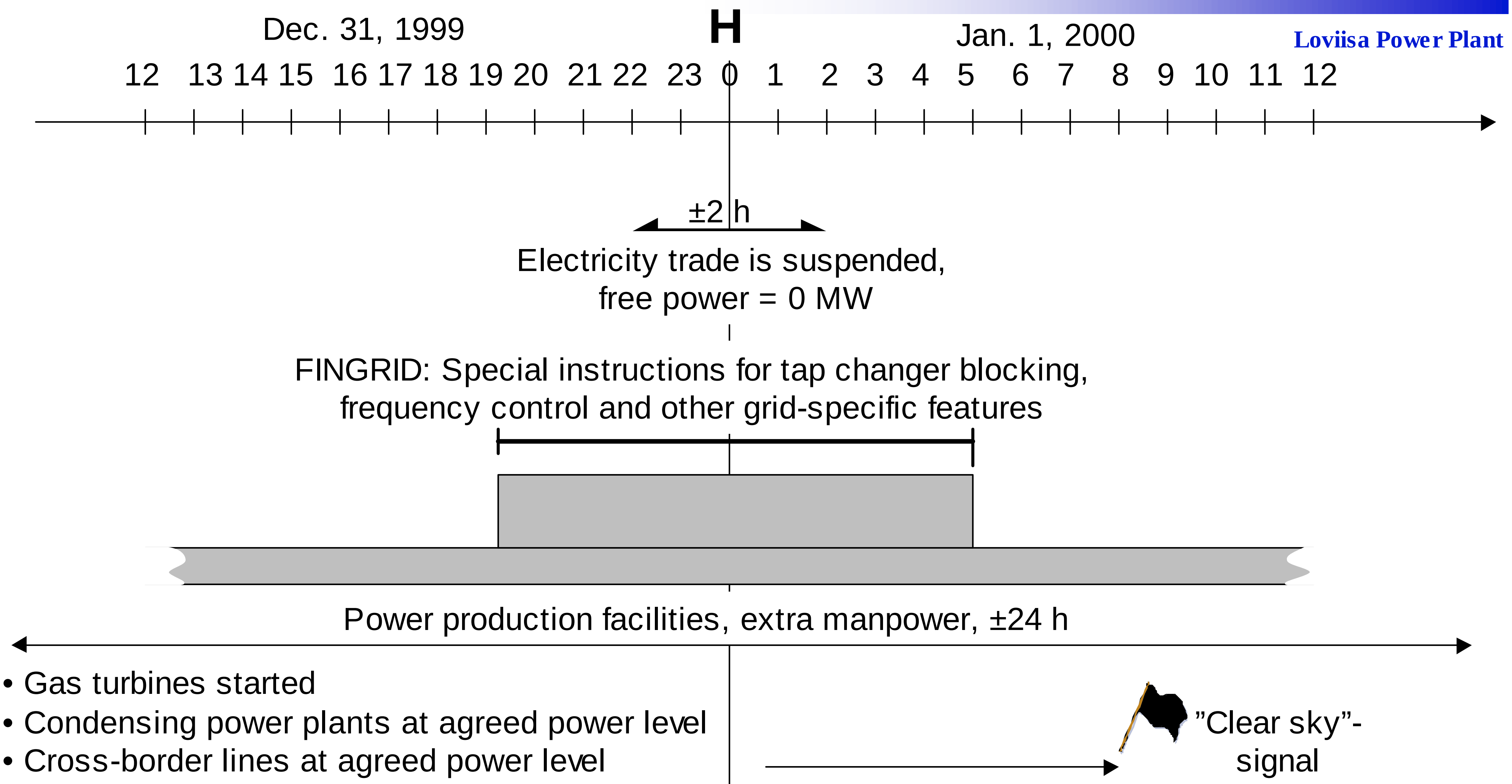
- Vulnerability low
  - No safety risk caused by Y2K (based on assessment)
  - Year 2000 project started well in time
  - The target of the year 2000 project: 100%
- Availability to the grid: good
  - No common cause risk identified
- Station service
  - Safety diesels 4 x 100%
  - Hydropower

Contingency planning

The Schedule

- Detailed plan for each power plant
  - ready before Christmas 1998
- Practical arrangements, training and instructing
  - August 1999 (at the latest)
- Gradual increase of readiness starts
  - Middle November 1999
  - Some programmed measures started 21.8.1999
- Full readiness
  - 24 hours before and after the transition from year 1999 to 2000

Contingency planning



- Gas turbines started
- Condensing power plants at agreed power level
- Cross-border lines at agreed power level
- Nuclear power in agreed condition
- Fuel + logistics in agreed condition
- Local special arrangements brought to readiness

Contingency planning

Questions and problems still exist

- National grid structure
  - 1000 km nort-south configuration
- Interties with other countries
  - Sweden, Norway, Russia
- Worst case scenario
  - Multiple failures in the grid and communications (“1000 km problem”)

Loviisa Power Plant

Conclusions

- Co-operation with suppliers is extremely important
- Good co-operation with authorities is important
- Multiple sources of information needed
- 1998 target date was met for most systems
- Year 1999 will be used for verification and contingency planning
- So far:
  - Year 2000 or any other date or time value will not cause any immediate safety or availability concerns at the Loviisa NPS.