

Ringhals Two Instrumentation & Control Exchange **TWICE**



Replacement of entire Main Control Room (MCR), I&C System (SS and SRS), new Simulator and enhanced race-way separation & segregation, Temporary Operations Provision (TOP), LES and a new Rod Control System and more.

Ringhals Two Instrumentation & Control Exchange **TWICE**



Ringhals Unit 2 (R2)

Type	Pressurized Water Reactor (PWR)
Net power	866 MW _e
Commercial Operation	1975

Reactor:

Supplier	Westinghouse
Thermal output	2,652 MW _{th}

Generators:

Supplier	Alstom Power AB
Generator Voltage	19.5 kV

Turbines:

Supplier	Stal-Laval Turbine AB
No. of Turbines	2
Rotation Speed	3,000 rpm
Cooling water flow	2*17,5 m ³ /s (2*6,180 ft ³ /s)

TWICE

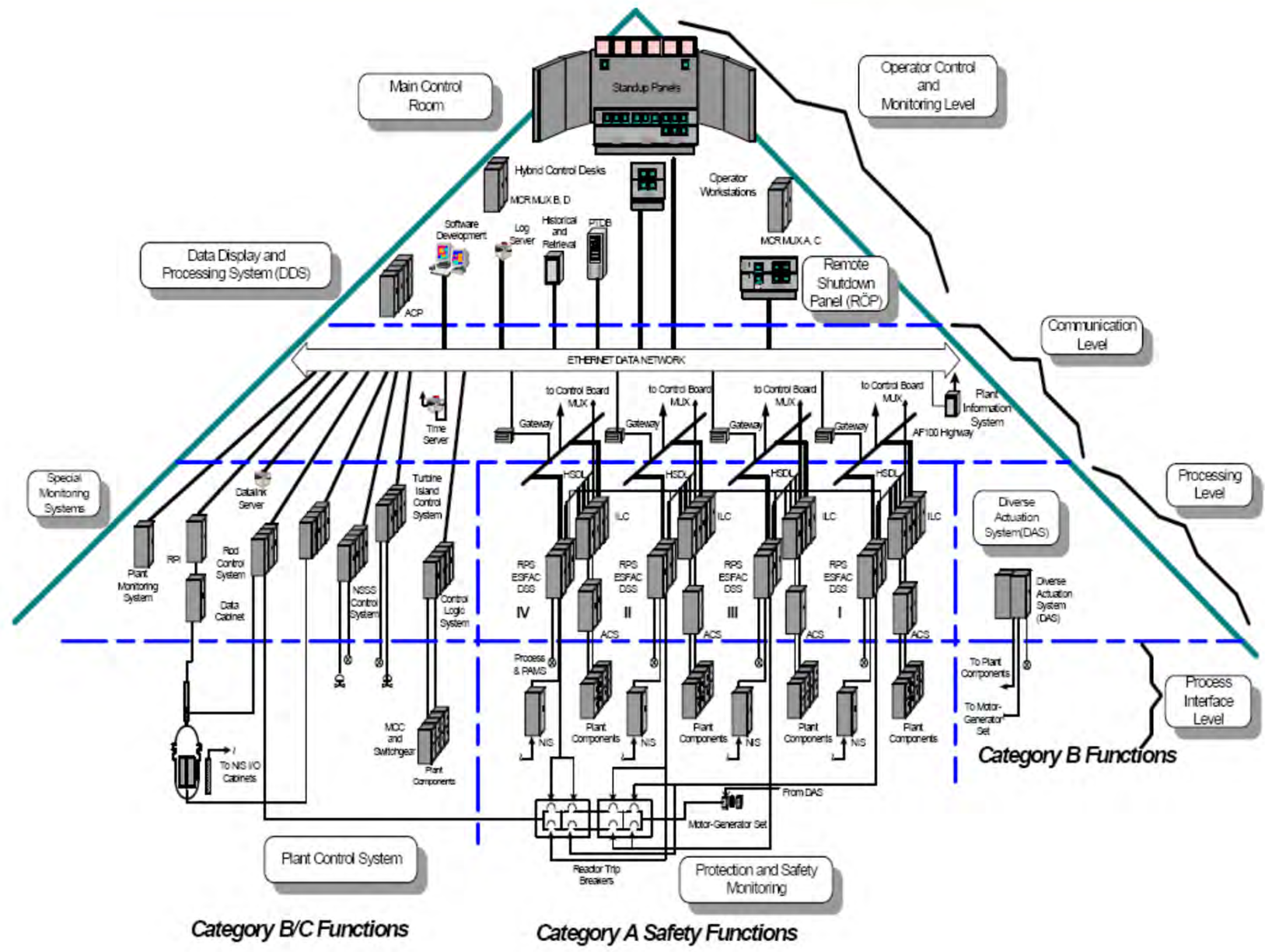
Basics

- ***New Software based I&C systems replaces 23 older analogical systems***
 - **Safety System (SS)**
 - ABBs AC160
 - Cabinets Situated in four newly built separate Safety Relay Rooms
 - **Safety Related System (SRS)**
 - Ovation (Emerson)
 - **Diversified Actuation System (DAS)**
 - **Alternate Control Panel (ACP)**
 - **Remote Shutdown Panel (RÖP)**
- ***New Main Control Room (MCR)***
 - Large Screen Displays, work stations and Mauell panels
- ***New Simulator***
 - A full-scale 'replica' of the MCR used for training and testing
- ***Lifecycle Engineering System (LES)***
 - Independent test and development system for the software used in TWICE
- ***Temporary Operational Provisions (TOP)***
 - Temporary Control Room (TCR) for monitoring functions to guarantee personal and plant safety (Radiation, fuel pit, fire alarms, ventilation etc.) during implementation.

TWICE

Basics (cont.)

- ***New Rod Control System***
 - Supplied by Mitsubishi
- ***Enhanced Separation and Segregation (Raceways)***
 - Four trains (A,B,C & D) for I&C-signals and power
 - New Electrical Penetration Assemblies (EPA) into Containment
 - IEC 61226 (“Cat. A”)
- ***Replacement of Field Mounted Equipment (FME)***
 - Original FME replaced by Transmitters etc.
- ***Commissioning and Testing***
 - Factory Acceptance Test (FAT)
 - Site Acceptance Test 1 (SAT 1)
 - SAT 2, Systems Test
 - Operational Acceptance Test (OAT)
- **QA**



TWICE

Decommissioned EQ

Scrapped and Recycled:

- *920 km (572 mi) Cable (~230 ton)*
- *220 Cabinets and larger objects*
- *1 MCR*
- *1,900 units of Field Mounted Equipment (FME) (transmitters, limit-switches, etc.)*



TWICE

Installation of New Equipment

- 328 Cabinets
- 600 Junction boxes
- 8,500 m (9,300 yd) of Race-way
- 40 km (25 miles) of Conduit
- 520 km (~310 miles) of Cable
- 21,500 Cable connections
- 1,773 new Field Mounted Equipment (FME)
- ~30,000 signals
- 1 MCR



TWICE

Documents

- **~100,000 Documents handled in total** (All at least once, some several times)
 - 48,000 Drawings/Circuit Diagrams
 - 1,500 Manuals
 - 11,000 Obsolete Documents
 - 17,000 Misc. Documents
 - 12,000 Test Reports



TWICE

Work By order

- 9,100 Work Permits/Work Orders
- 60,000 keys handed out (All keys has been returned)
- Only 8 Accidents/Incidents during implementation
- 800 people accommodated in Floating Hotel (Bibby Challenge)
- 340 kg (750 lb) of Candy



TWICE

Timeline Major Events

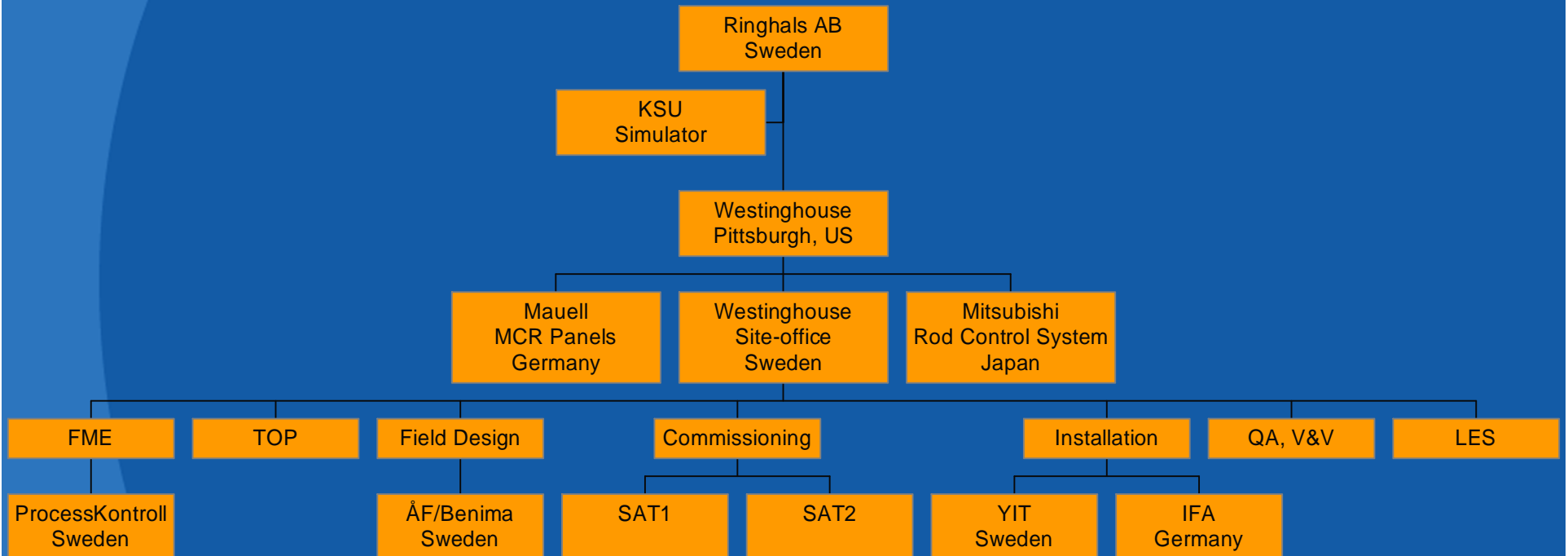
- 1995-1999 Pilot Studies and price quotations.
- 1999-03-26 RAB signed contract with Westinghouse
- 2001 WP1 (WDP) Installed
- Dec 2002 Contract Renegotiated (2 year Delay)
- 2005-2007 Contract Renegotiated (impl. 2009)
- 2007 Simulator Complete
- 24 May 2009- Final Installation and Testing (Outage)
- 28 Sept 2010 OAT Approved (Length of outage: 289 Days)



*And all along the way:
Work, work and more work.*

TWICE

Organization



TWICE

Lessons Learned: Planning

Planning:

- The time schedule was never ever realistic.
 - Always leave some time for the unforeseeable and unexpected.
 - During a project that spans over 10 years: new requirements will arise during the journey.
- The Need for Resources increased over time
 - Ringhals and Westinghouse resources needed in the project increased compared to what was expected in the beginning of the project.
- Co-ordination between several different time schedules and parties didn't work.
 - **One Plant, one Schedule!** Not only in theory but in reality as well!
- Having the same, committed and engaged, people throughout the whole project is an major advantage.
 - Both for 'Key-positions' and 'Crew'

TWICE

Lessons Learned: Communication

Communication:

- **Good Communication is vital**
 - Communication between different areas of expertise/departments was sometimes 'non-existent': "No man is an Island!"
 - Working in different time zones is sometimes helpful for 'fast' communication.
 - Communication during SAT Trouble-shooting was poor and created a lot of unnecessary work for all parties.
 - During the outage the communication between the project and maintenance-departments was very good.

TWICE

Lessons Learned: Misc.

Misc.

- The Simulator was a big help during FAT.
 - A vast number of issues was eliminated.
- You can save a lot of time, effort and money:
 - ...by not making haste.
- Qualification/Classification of Equipment
 - National Government Reqs. may exceed the International reqs.
 - Having both IEC (6)1226 and ANSI/308/603 classification in an existing plant sometimes makes it harder to harmonize policies.
- Reality vs. Documentation
 - Reality and Documentation doesn't always match

TWICE

Lessons Learned: Misc.(cont.)

Misc.

- Having several Large Projects implemented at the same time takes it's toll on the customers organization and resources.
 - TWICE.
 - RPS
 - (NICE/GREAT)
- Daylight Saving time:
 - Dates for start and end of daylight saving times should be harmonized ☺

TWICE – New MCR Layout



R2 – Main Control Room 1974



TWICE – New Reactor Panel



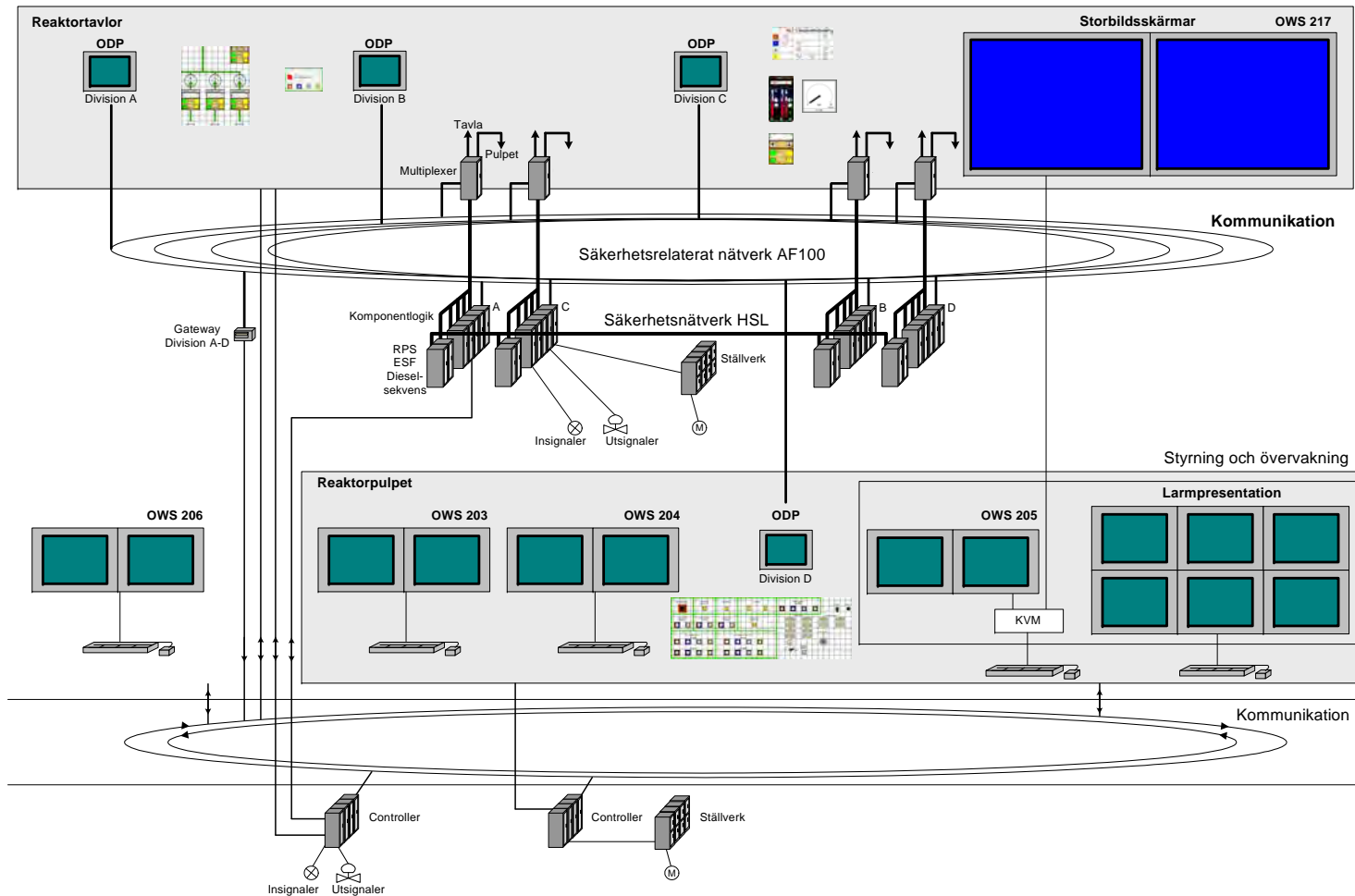
TWICE – New Turbine Panel



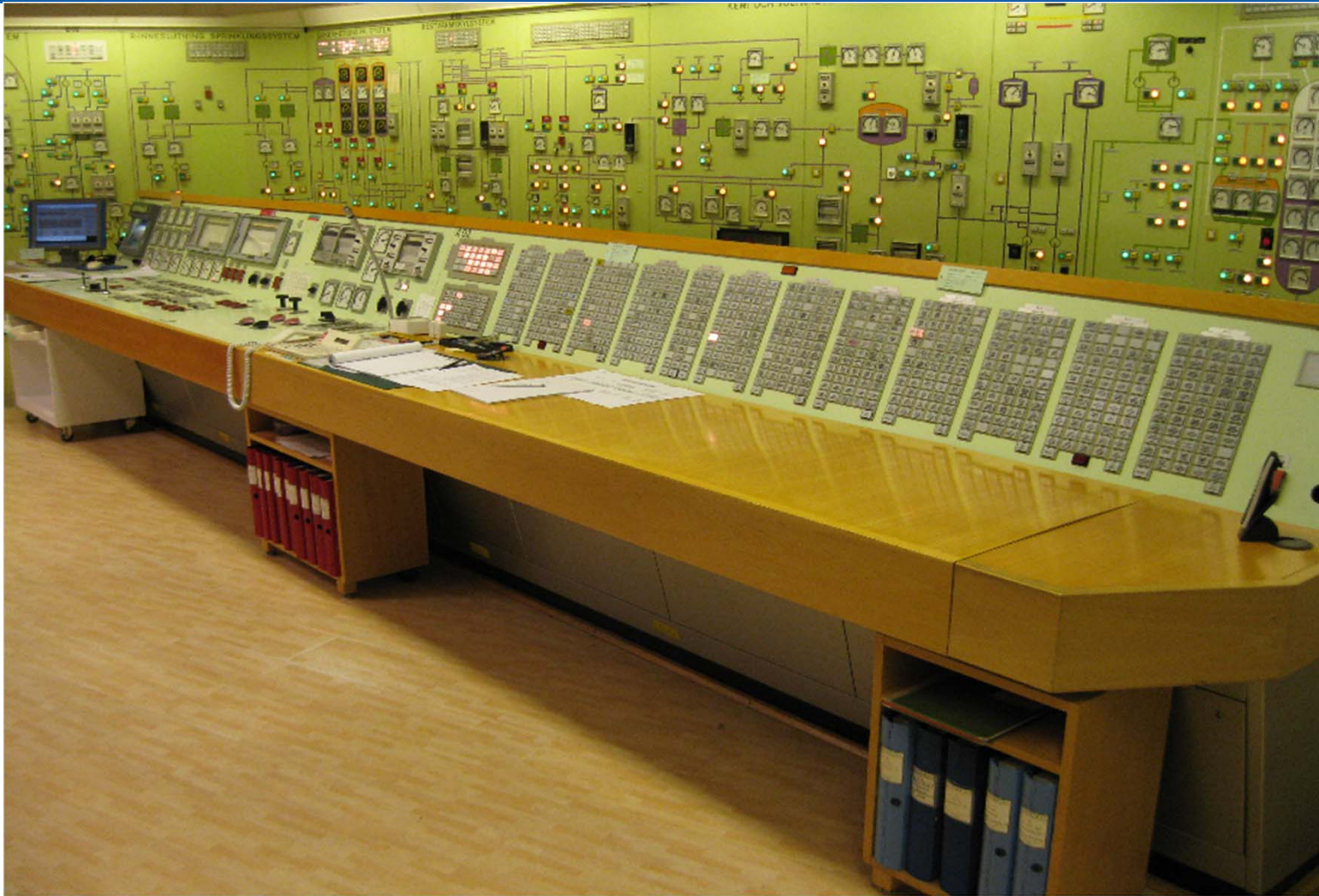
TWICE – New Electrical Panel



TWICE – I&C Platform Reactor



R2 – Reactor Panel 1974



R2 – Turbine Panel 1974



Decommissioning - MCR



Decommissioning - MCR



Decommissioning – Outside MCR



Decommissioning - Outside MCR



TWICE – Installation - MCR



TWICE – Installation - MCR



TWICE – Installation - MCR



TWICE – Installation - MCR



TWICE – Installation -MCR



TWICE – Installation – Relay Room



TWICE – Installation – SRS Cabinets



TWICE – Installation – Relay Room



TWICE – Installation – SRS Relay room



TWICE – Installation – SRS Cabinet



The most important thing is... to help each other!



Co-operate,



And to communicate.

