

# Ageing Management and SSC's Improvements at IRR1

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SNRC

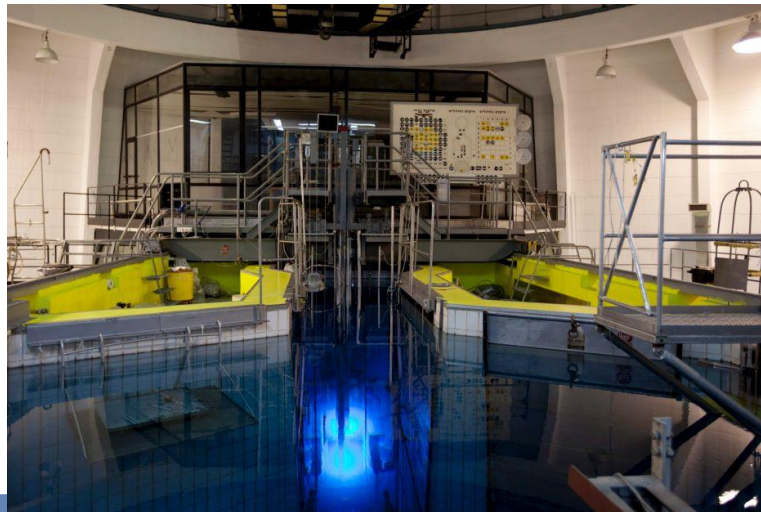
Israel

# Content

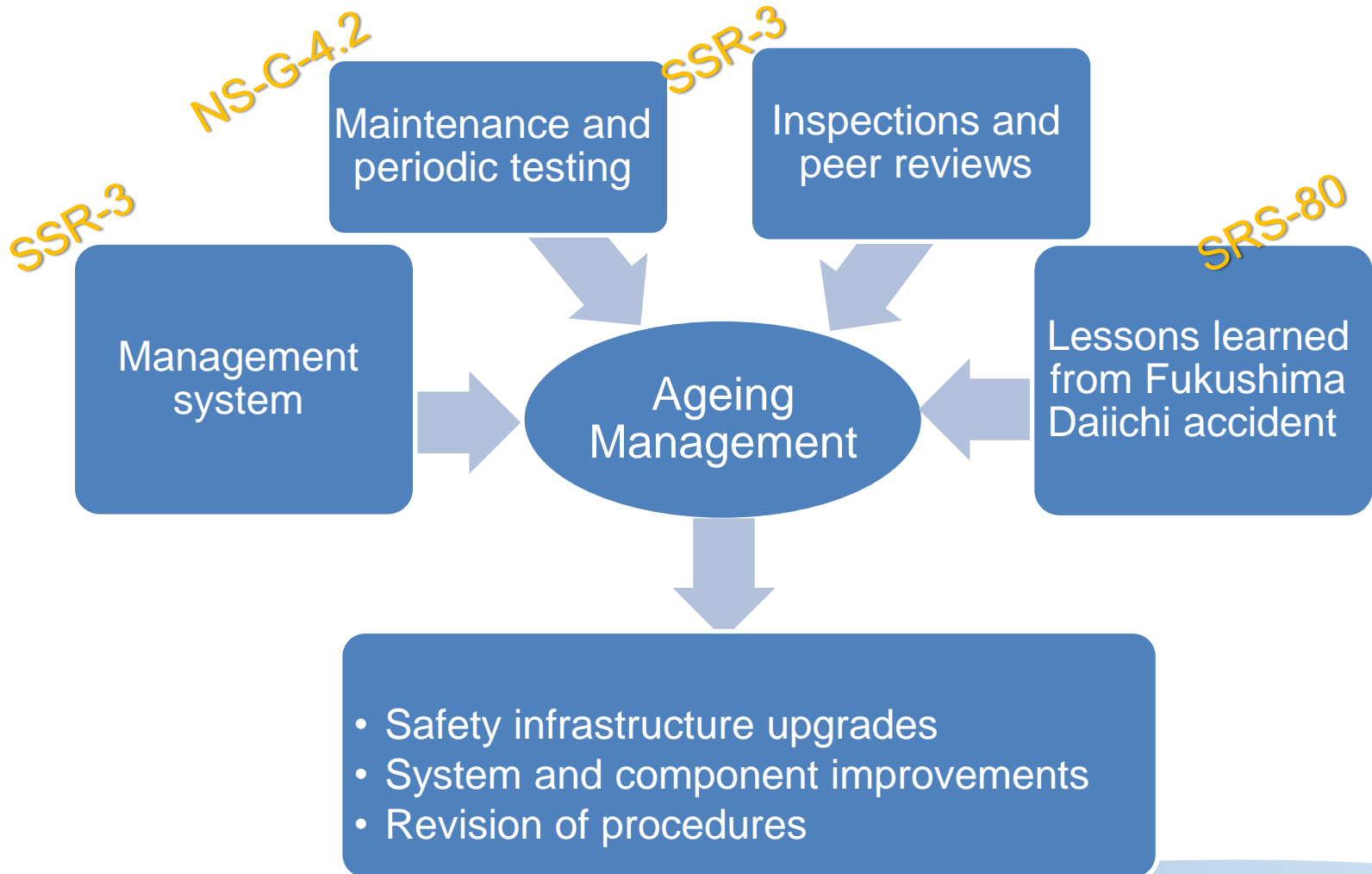
- IRR1 overview
- Ageing Management
- Management System, maintenance and periodic testing
- Inspection and peer review
- Lessons learned from the Fukushima Daiichi Accident
- Implementation
  - Flow regulating system
  - Control room renovation
  - Replacement of servo-power regulating unit
  - Upgrading the Rabbit's (pneumatic conveyer) control system
  - Upgrading the confinement isolation mechanism
- Conclusions

# Israeli Research Reactor-1

- First criticality: July, 1960
- Reactor type: MTR, HEU (93%), Swimming Pool type
- Power: 5 MW
- Moderator + Coolant : H<sub>2</sub>O
- Utilization: Industrial neutron radiography; Neutron diffraction; Activation analysis; Nuclear physics and health physics research; Students educating , public education and awareness.

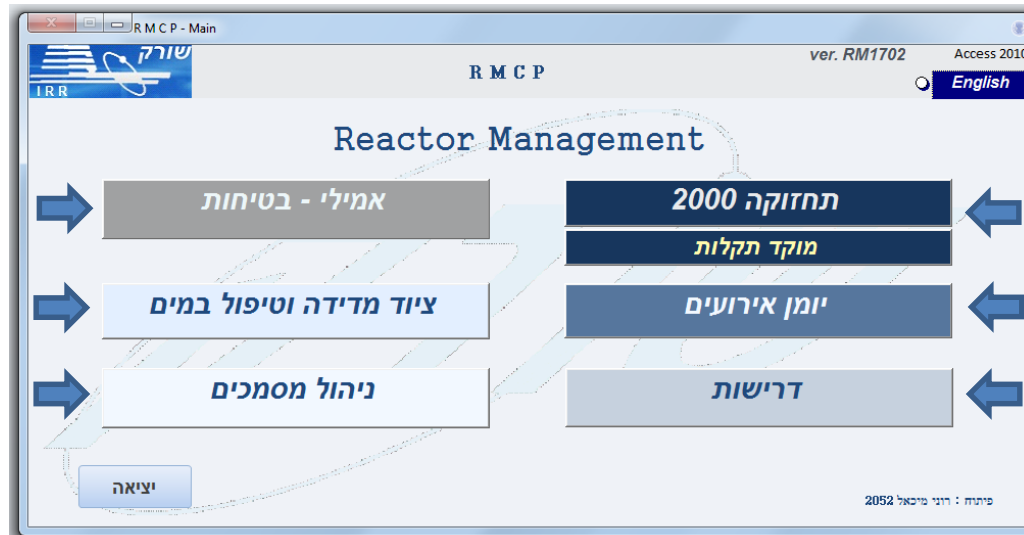


*“In practice, the ageing management program at a research reactor is accomplished by coordinating **existing programs**, including **maintenance, periodic testing and inspection programs**” [IAEA SSG-10]*



# Management system (RMCP-Reactor Management Computerize Tool)

- Monitoring staff training, authorizations, enrichment activities etc.
- Special equipment monitoring: calibration of measurement equipment and equipment status.
- Quality assurance (management system) of documentation (procedures, drawings etc.).
- Maintenance management and equipment data base.
- Analyzing database and help in planning future actions.



Personnel safety

Water analyzing

Data management

Maintenance

Logbook

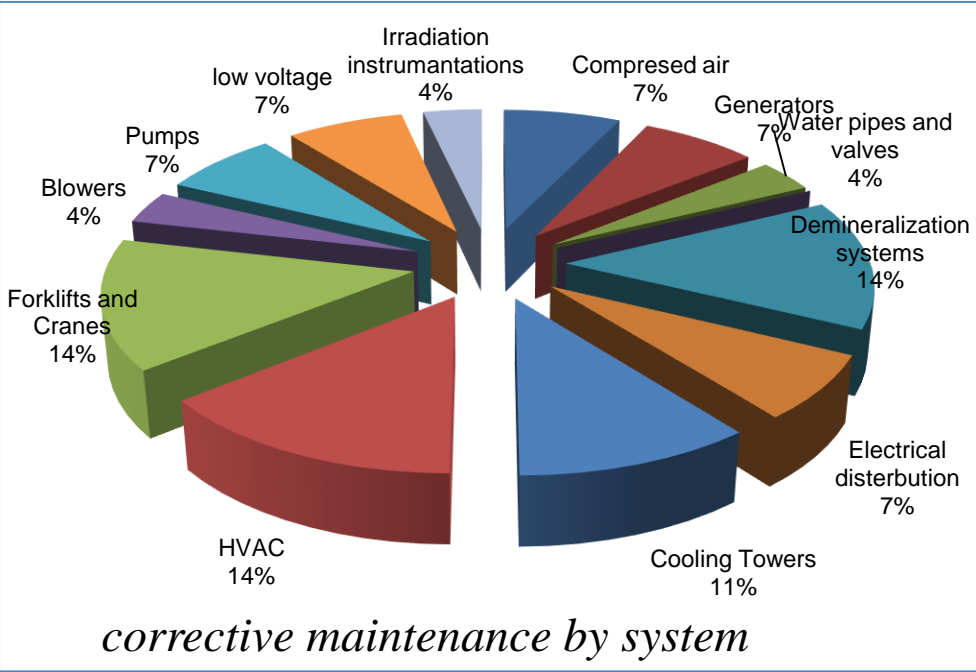
Logistics

# RMCP maintenance module examples

- Annual preventive maintenance reminders
- Equipment database
- Statistics

תוכנית טיפולים שנתיים למערכות

| שם המערכת         | שנתי שבועי (עדכון) | טיפול שנתי הבא | לפי צורך (תזכורת) |
|-------------------|--------------------|----------------|-------------------|
| מרכיבים           | 31/08/2017         | 31/08/2018     |                   |
| חשמל              | 30/08/2017         | 30/08/2018     |                   |
| מתקני הקרנה       | 15/08/2017         | 15/08/2018     |                   |
| מיזוג אוויר       | 25/07/2017         | 25/07/2018     |                   |
| מתח נמוך מאוד     | 11/07/2017         | 11/07/2018     |                   |
| מגדלי קירור       | 27/06/2017         | 27/06/2018     |                   |
| כיבוי אש          | 28/05/2017         | 28/05/2018     |                   |
| מלגזות            | 11/05/2017         | 11/05/2018     |                   |
| צורת משנית        | 10/05/2017         | 10/05/2018     |                   |
| חימום             | 05/03/2017         | 05/03/2018     |                   |
| גנרואטורים        | 01/02/2017         | 01/02/2018     |                   |
| ווא גמא           | 16/01/2017         | 16/01/2018     |                   |
| מתקני שתיה        | 08/01/2017         | 08/01/2018     |                   |
| עגורים            | 14/12/2017         | 02/01/2018     |                   |
| מפוחים            | 01/04/2018         | 29/12/2017     |                   |
| סיהור תחם         | 26/12/2016         | 26/12/2017     |                   |
| אלקטרוניקה - נטור | 18/12/2016         | 18/12/2017     |                   |
| אוויר דחוס        | 04/12/2016         | 04/12/2017     |                   |
| סיהור קרה         | 01/12/2016         | 01/12/2017     |                   |
| צורת האשפות       | 01/12/2016         | 01/12/2017     |                   |
| מבנים             | 24/11/2016         | 24/11/2017     |                   |
| אתחן חרם          | 02/11/2016         | 02/11/2017     |                   |
| הפעלה             | 31/10/2016         | 31/10/2017     |                   |
|                   | 24/10/2016         | 24/10/2017     |                   |



דוח נתוני פריטים

עדכון והוספת פריטים

קוד הפריט: 5659

שם הפריט: מד ספיקה ABB

קוד היצרן: 2200004228

מחיר כולל מע"מ: 14,100.00

פרטים נוספים:

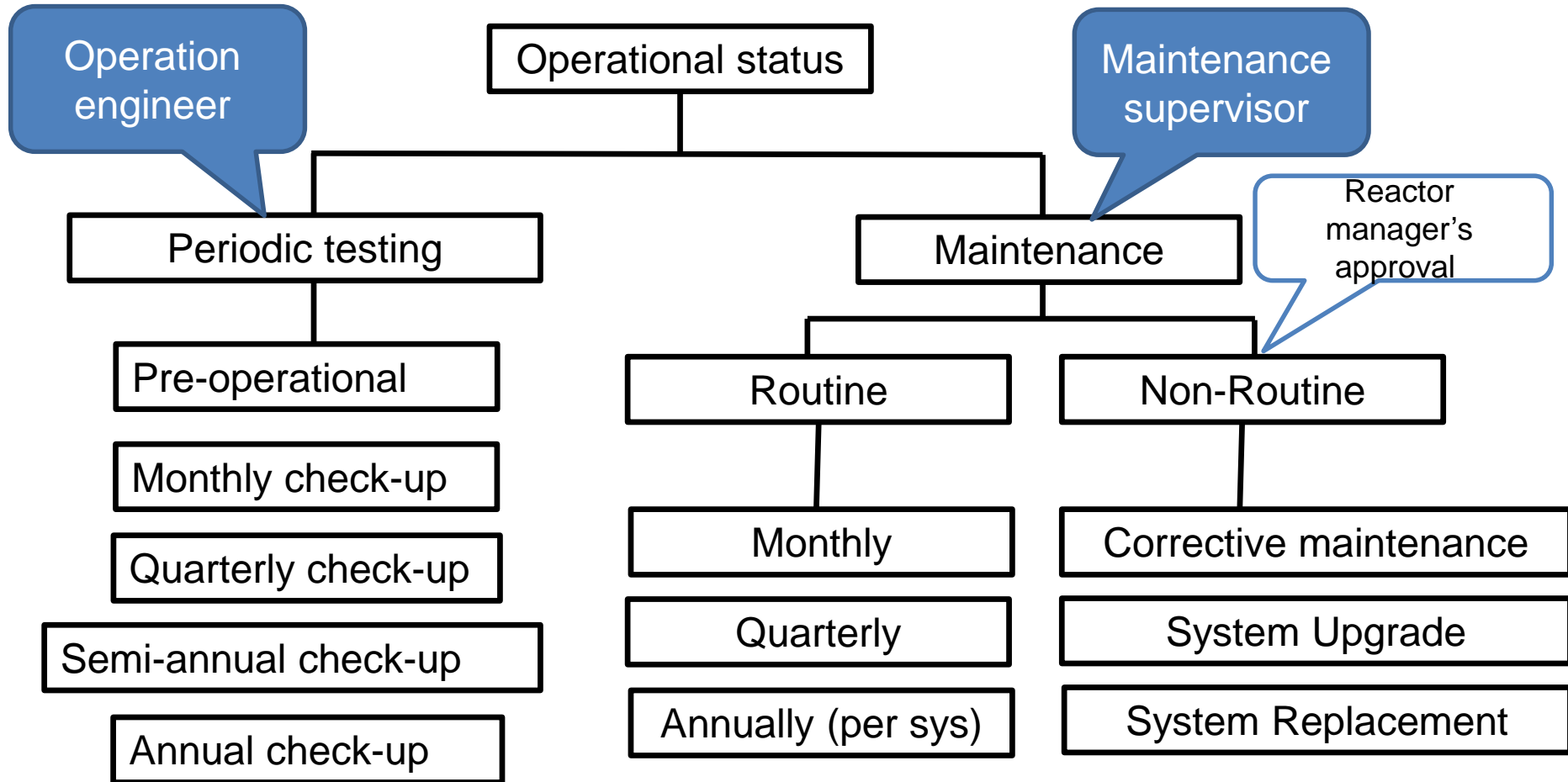
אזור: ארץ ישראל

מיקום: מנהרת בית משאבות

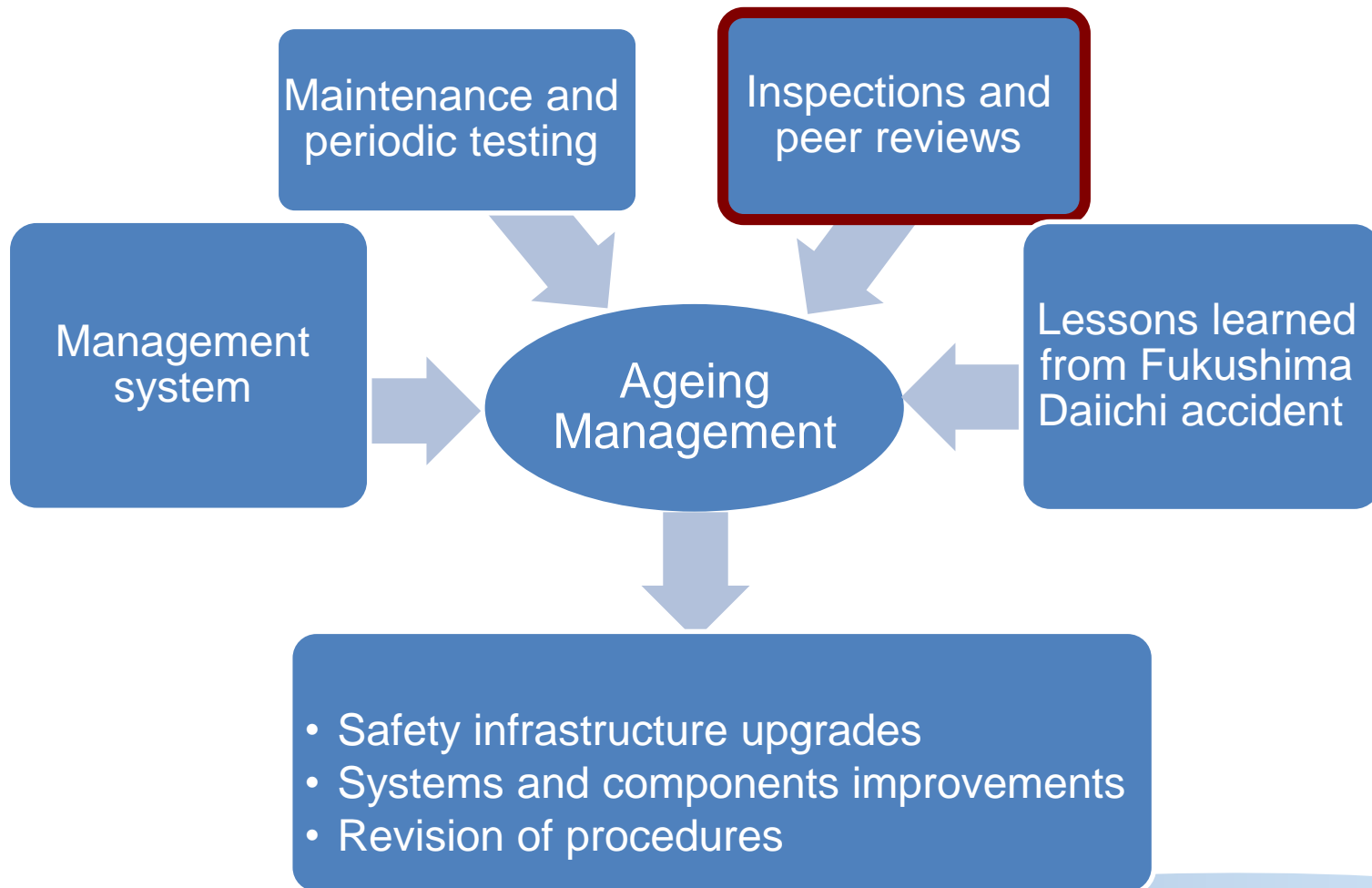
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מחיר הרכישה: 20/07/2017

# Maintenance and periodic testing

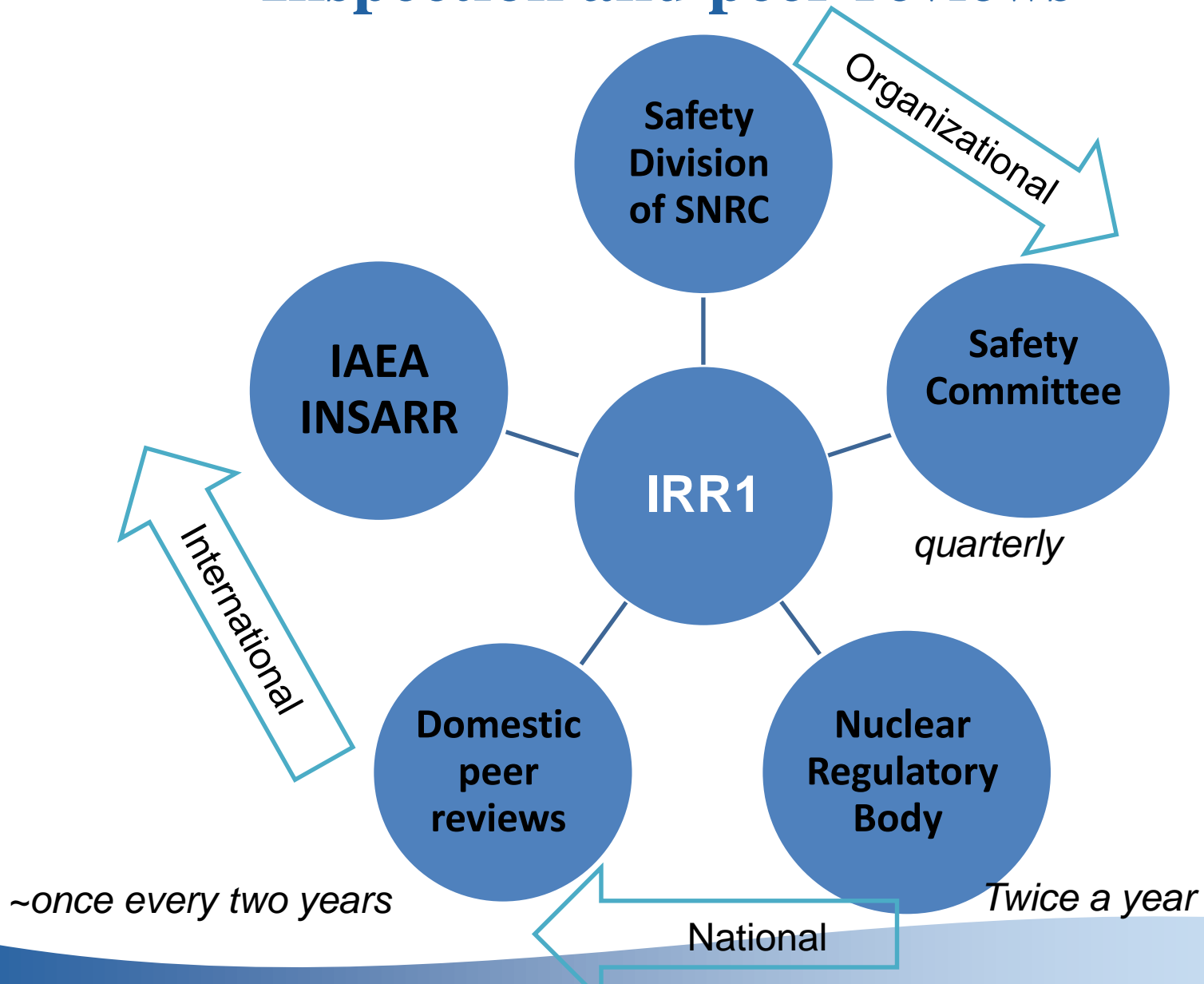


*“In practice, the ageing management program at a research reactor is accomplished by coordinating **existing programs**, including **maintenance, periodic testing and inspection programs**” [IAEA SSG-10]*

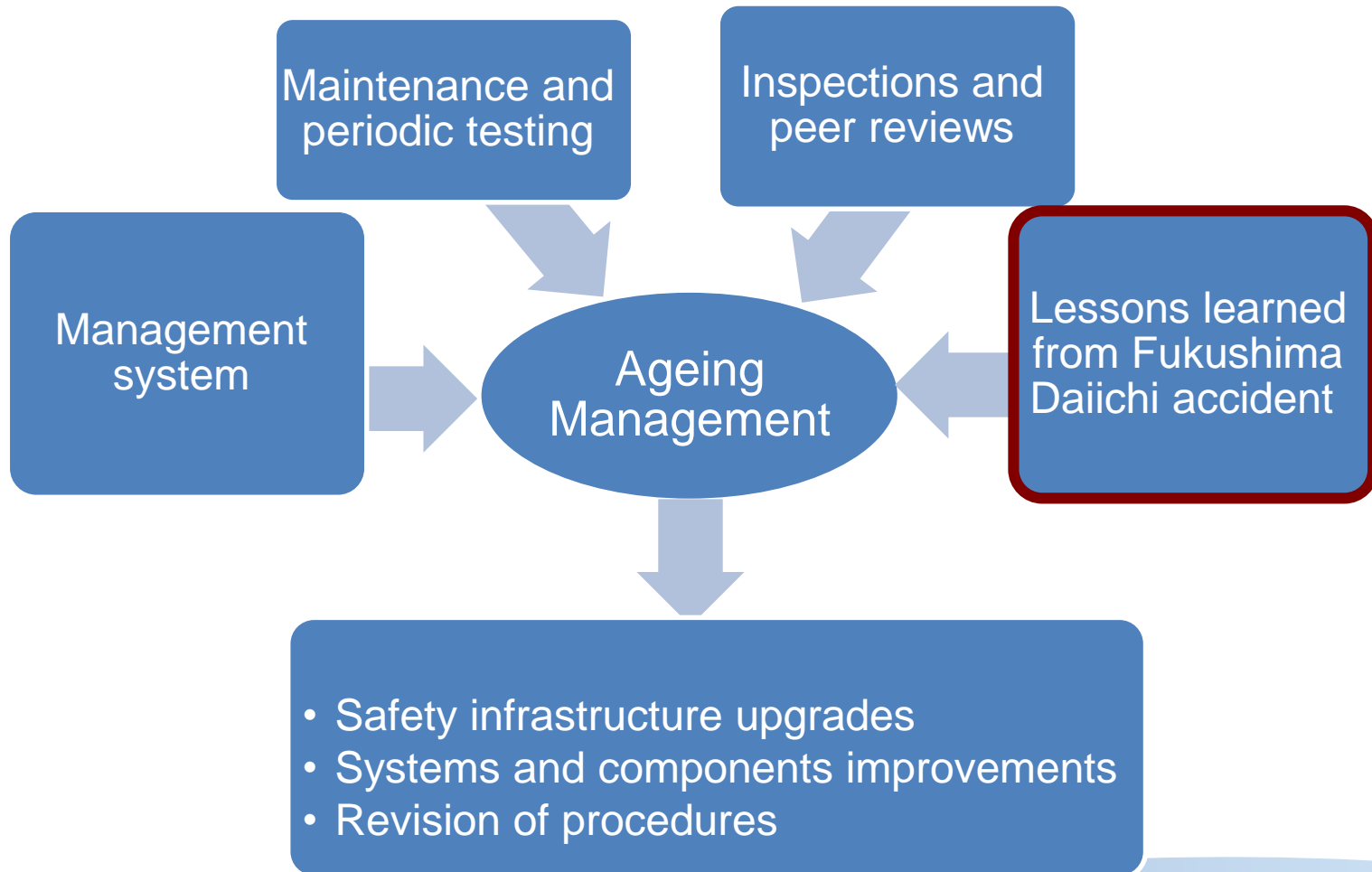




# Inspection and peer reviews



*“In practice, the ageing management program at a research reactor is accomplished by coordinating **existing programs**, including **maintenance, periodic testing and inspection programs**” [IAEA SSG-10]*



# Lessons learned from Fukushima Daiichi accident

Fukushima accident has catalyzed interface-procedures in reactor licensing process. Major benefit to aging-management is an agreed-upon action-plan, involving both the regulator and the facility, based on IAEA SRS-80:

- Complementary operational procedures.
- Installation of accelerometer for triggering automatic shutdown.
- Dynamic analysis of key systems.
- Upgrade of Electrical and Water-Supply system.

\* Int. Conf. on RR Safe Management and Effective Utilization, Vienna, Nov. 2015.

# Implementation - Example #1

## Renewal of flow regulating system (1/3)

- Several 10" butterfly valves regulate the flow rate of the primary cooling system (installed 40 years ago).
- Degradation (difficulties in operation, leaks) and obsolescence (lack of spare parts) necessitated renewal of this safety related system.

*Old diaphragm actuator*



*Old butterfly valve*

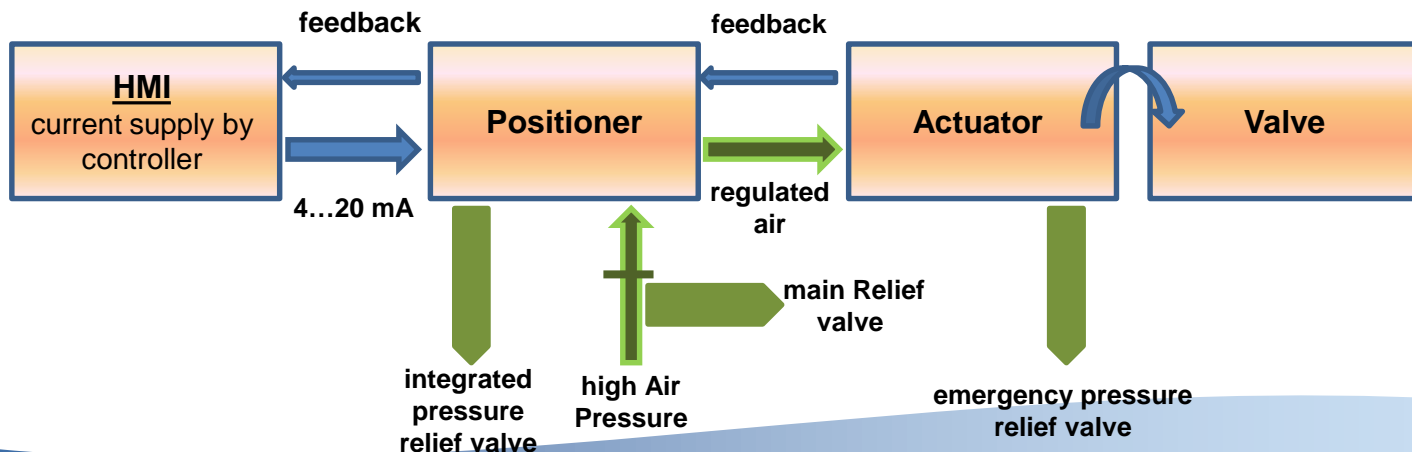


## Renewal of flow regulating system (2/3)

The new system is based on:

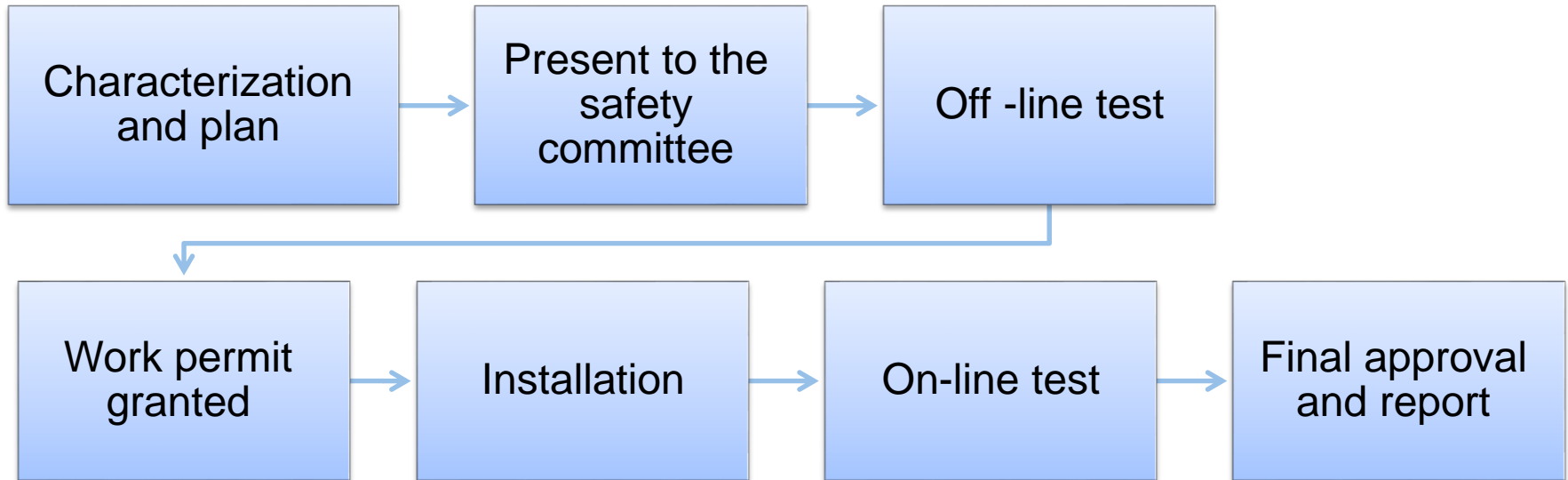
- Fail Safe actuator (normally closed).
- Electro-pneumatic control instead of full pneumatics.
- Electronic and electro-mechanic component – approved according IEC-61508 with SIL 2/3.
- No change in valve location nor valve size.

### Principle of operation



# Renewal of flow regulating system (3/3)

## Valves system: Installation and commissioning



*off-line commission testing*



*old system (right) vs new (left)*





# Implementation – Example #2

## Control Room Renovation

- Control console
- Chart recorders
- New fire detection and extinguishing system
- Upgrade the UPS units
- Data acquisition (DAQ) and HMI systems

*control room view- 2007*



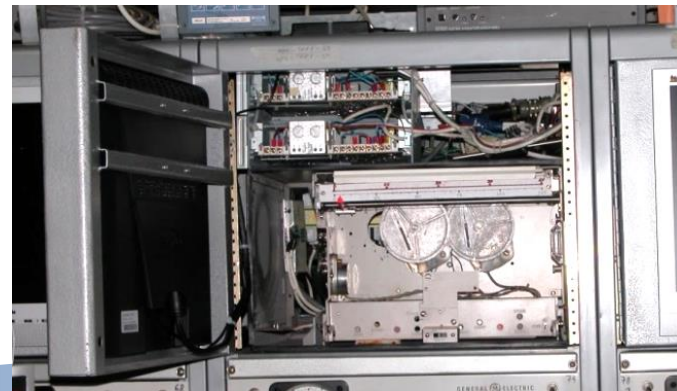
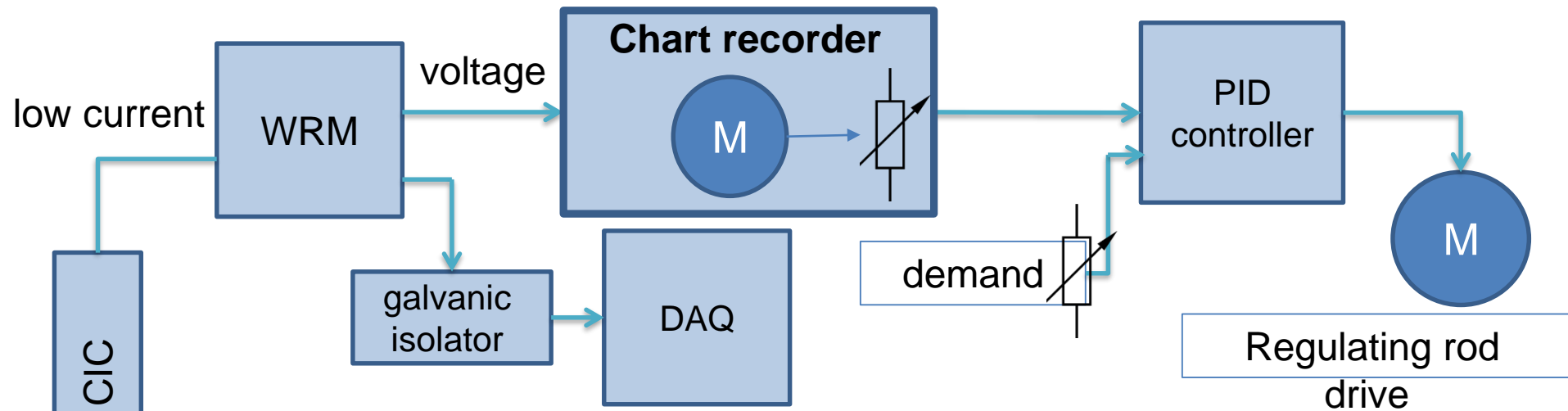
*control room view- 2017*



# Implementation - Example #3

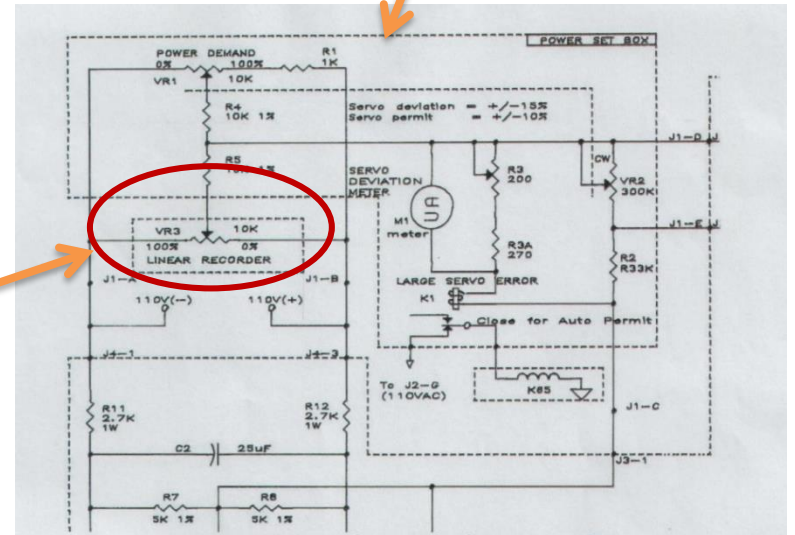
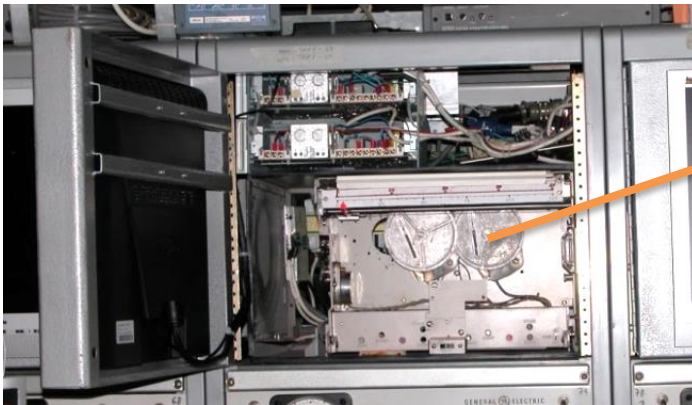
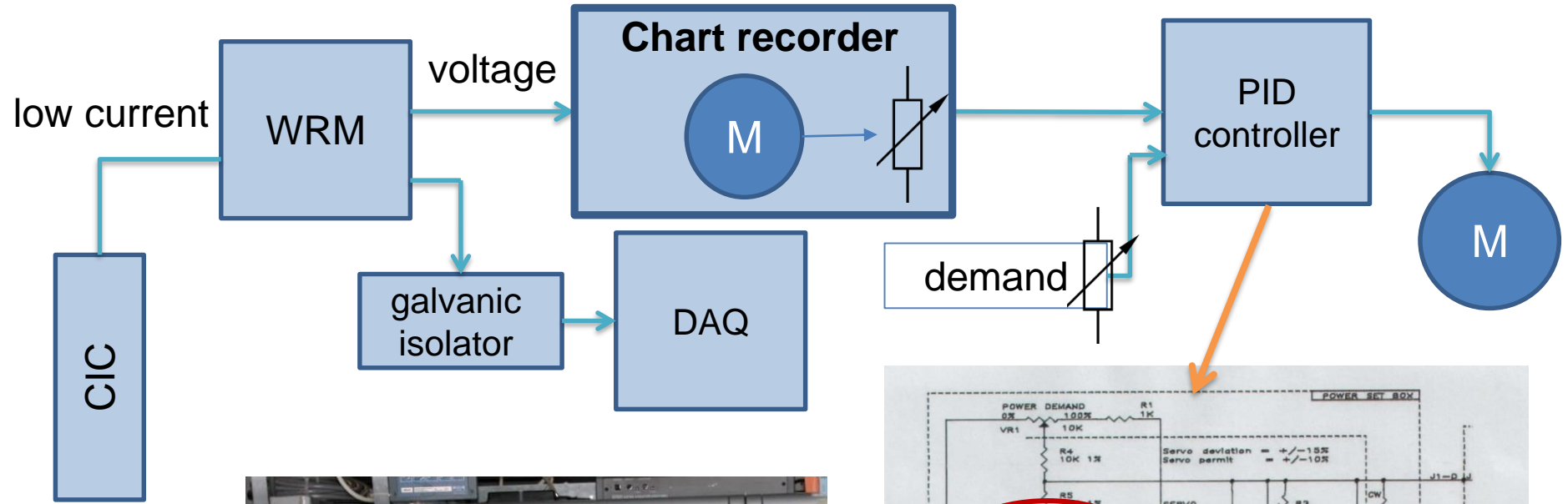
## Replacement of servo power regulating unit (1/4)

**Servo unit objective:** to convert the output of the Wide Range Monitor (voltage) to the input of the regulating rod controller (resistance)

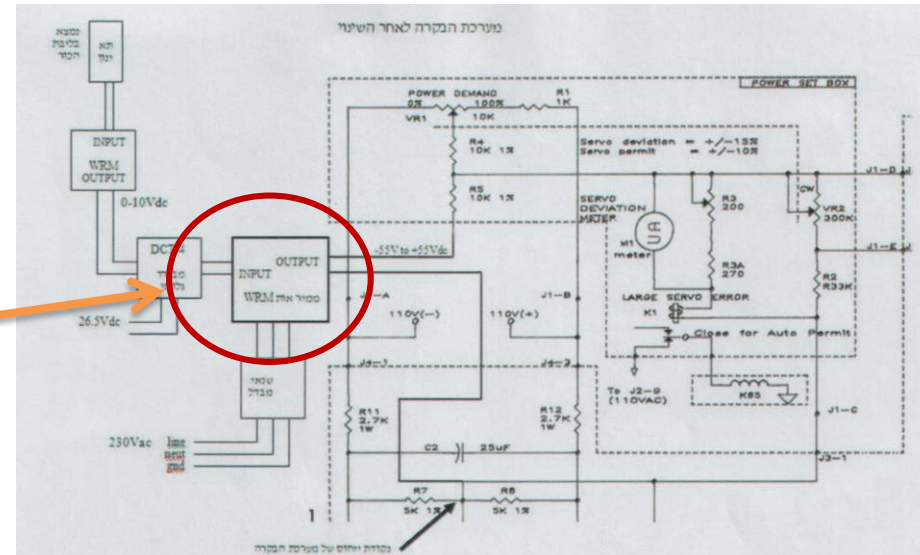
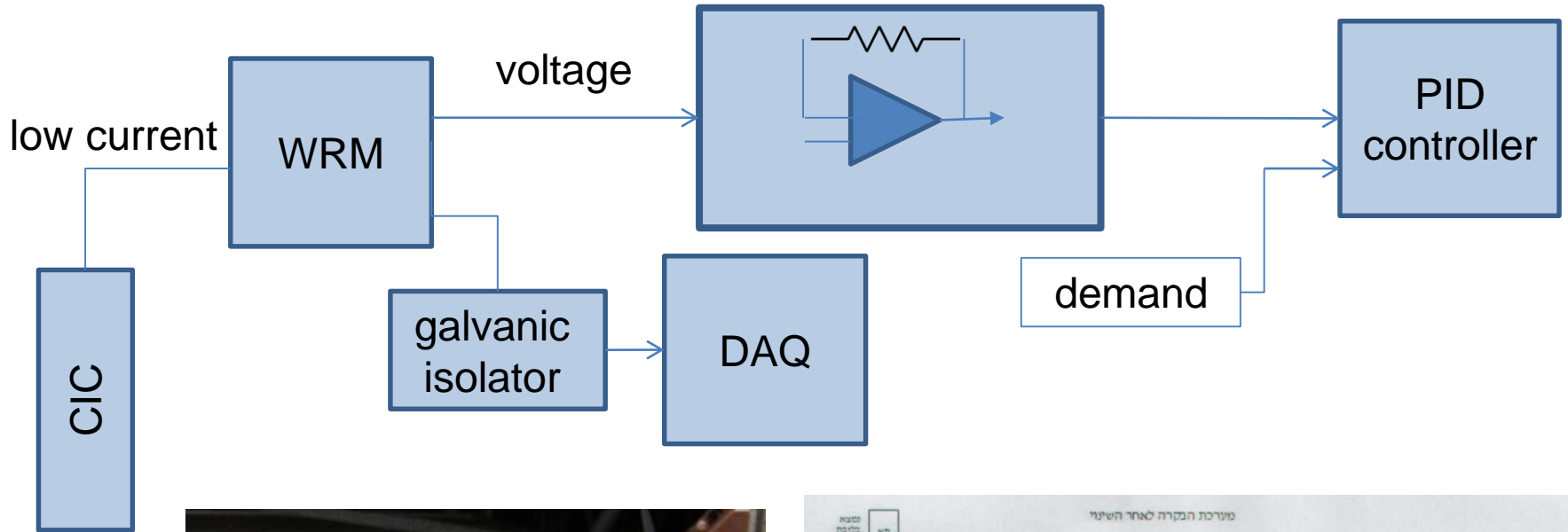




# Replacement of servo power regulating unit (2/4)



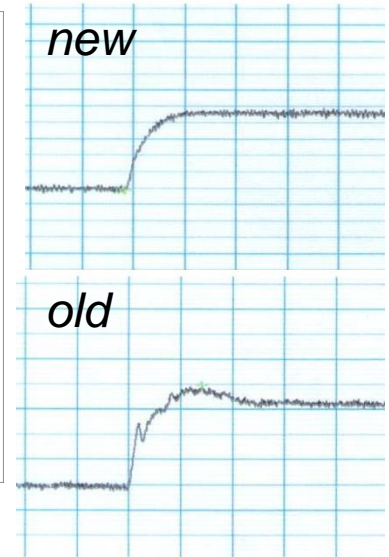
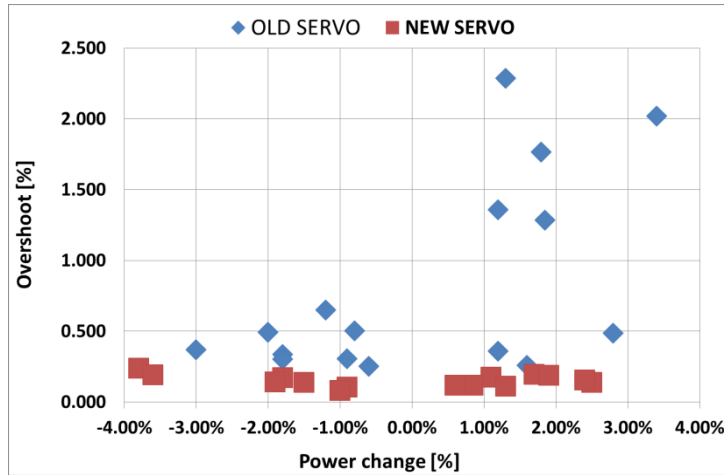
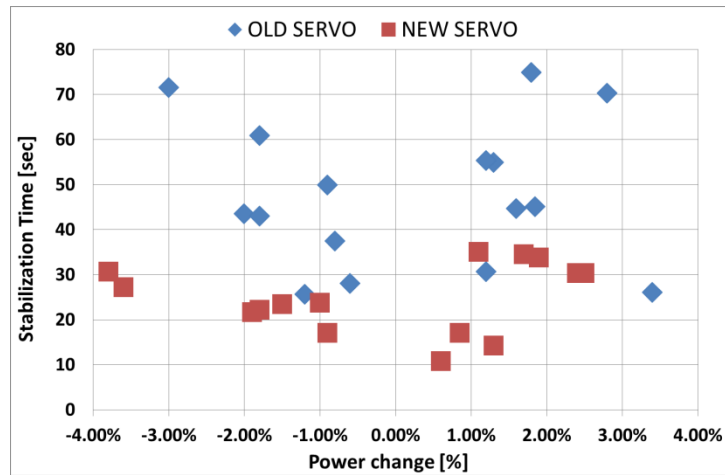
# Replacement of servo power regulating unit (3/4)



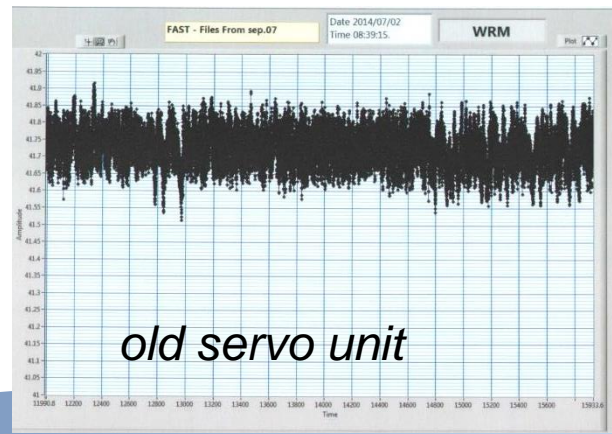
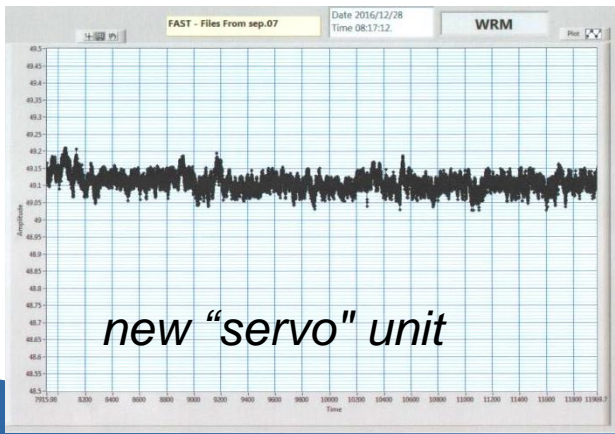
# Replacement of servo power regulating unit (4/4)

## New “servo” unit – commissioning tests

### Stabilization time and overshoot – step power demand response



### Steady-state example





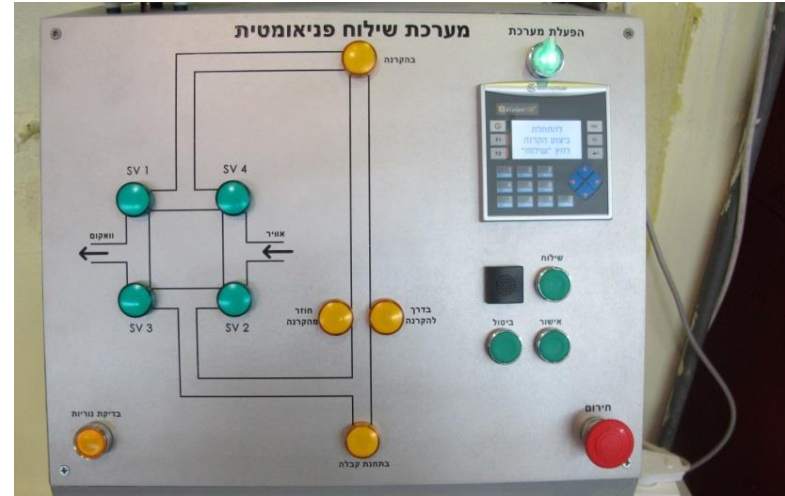
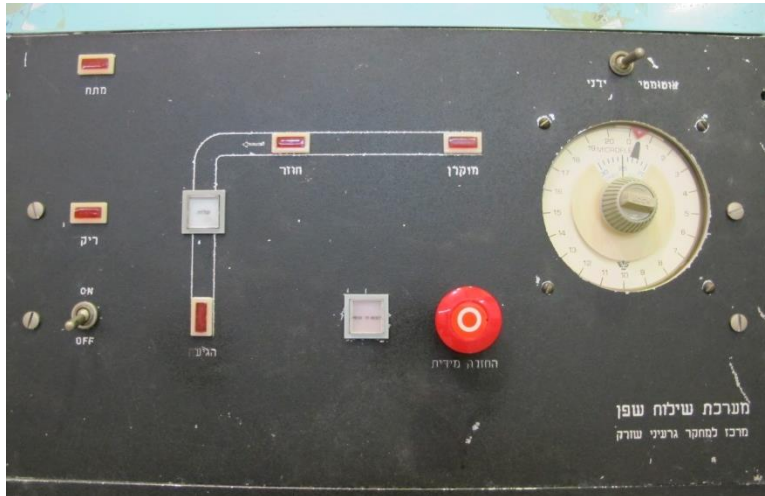
# Implementation - Example #4

## Upgrading the Rabbit's Control System

- Obsolescence of the system
- Malfunctions of the electronic and electro-mechanic devices



- Controlled by PLC
- Advanced safety features
- Standard components



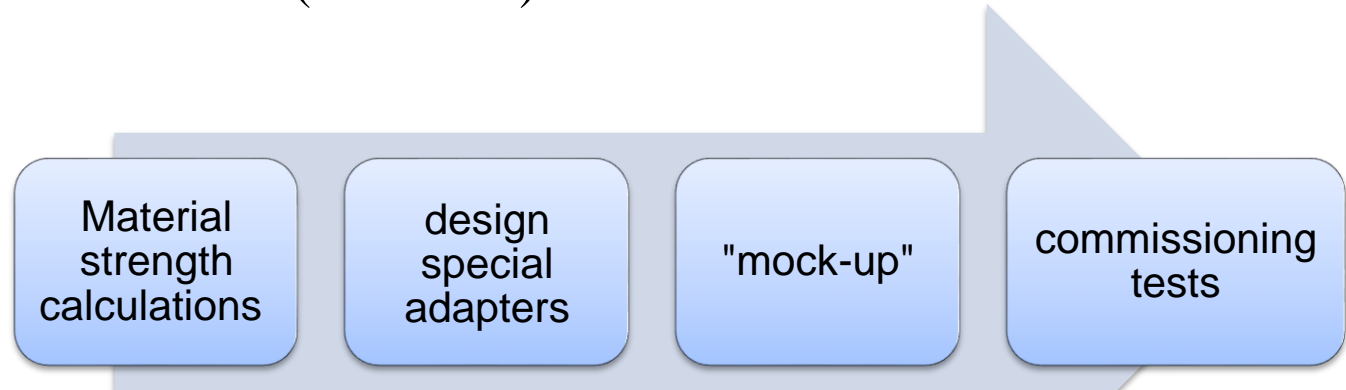
# Implementation - Example #5

## upgrading the confinement isolation mechanism



The old mechanism: an electromagnet with a mechanical latch  
 The new concept is based only on the electromagnetic coupling

- “Fail safe“ design.
- “Off the shelf" products, which are used in safety systems for fire protection doors (UL listed).



## Conclusions

- In recent years, IRR1 underwent major upgrades and improvements as part of an ageing management program.
- Obsolete SSC's are updated by modern state-of-the-art solutions.
- Existing programs and lessons learned from special occasions were integrated into the ageing management program.
- We will be happy to share our experience and knowledge with other RR groups.

**Thank You!**