

# Temperature and radiation measurements at Forsmark

COMRADE 4/12-2018

# Equipment

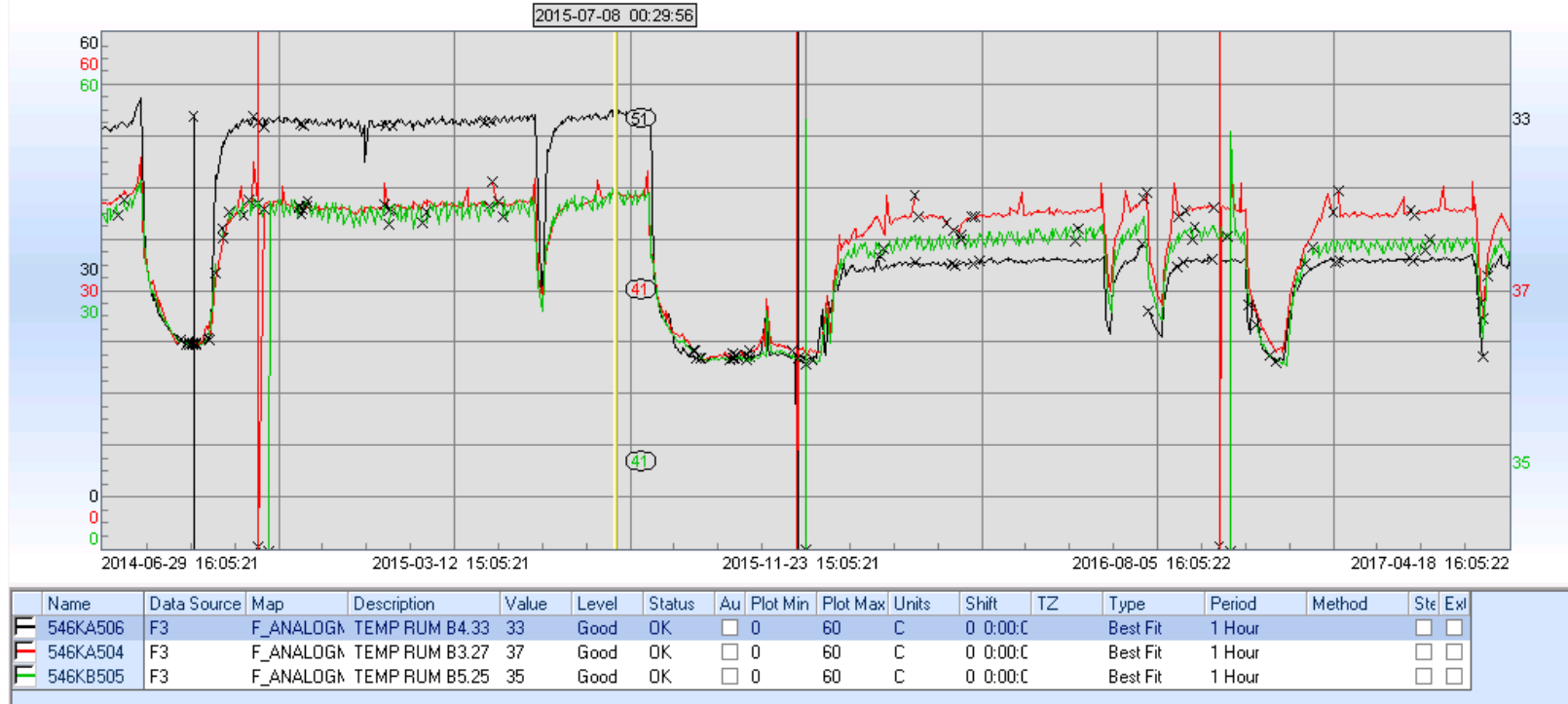
- IR-camera
- Battery operated temperature loggers
- Alanine dosimeters (10 Gy – 200 kGy)
- Online temperature measuring



# Online monitoring

- In the plant there are temperature monitoring in some rooms. The temperatures and trends can be viewed in the "Plant Explorer" system.

# Plant explorer, example

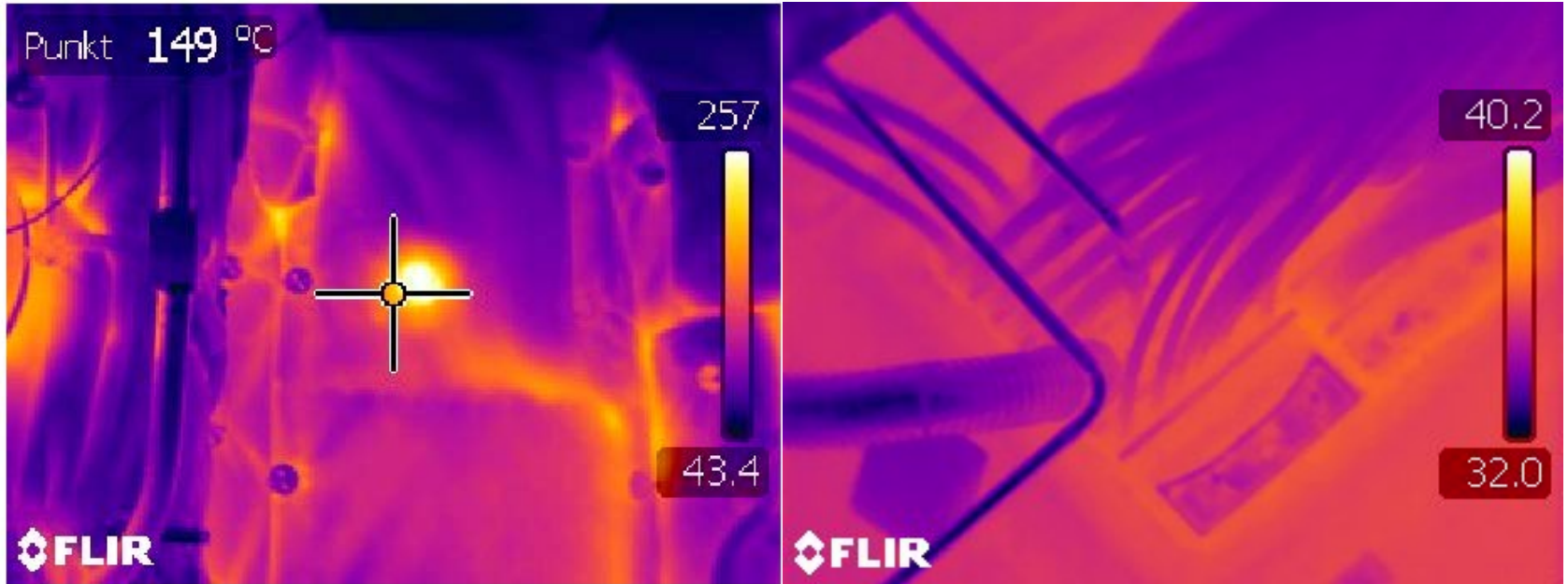


# In the field

- The IR camera is used for inspection inside containment direct after shut-down of the plant.
  - **The systems should be as hot as possible.**
- With the camera we look for areas that is hotter than the surroundings.
- We often locate bad insulation
- If we don't find anything alarming we use the results to determine locations for the temperature loggers.



# Examples



# In the field

- Walk downs is performed in areas that can get a harsh environment and where components can get a ambient temperature that is exceeding the limits for the equipment.
- Indications on local hot spots are damaged insulation, colour changes on walls, cables etc.



# Examples





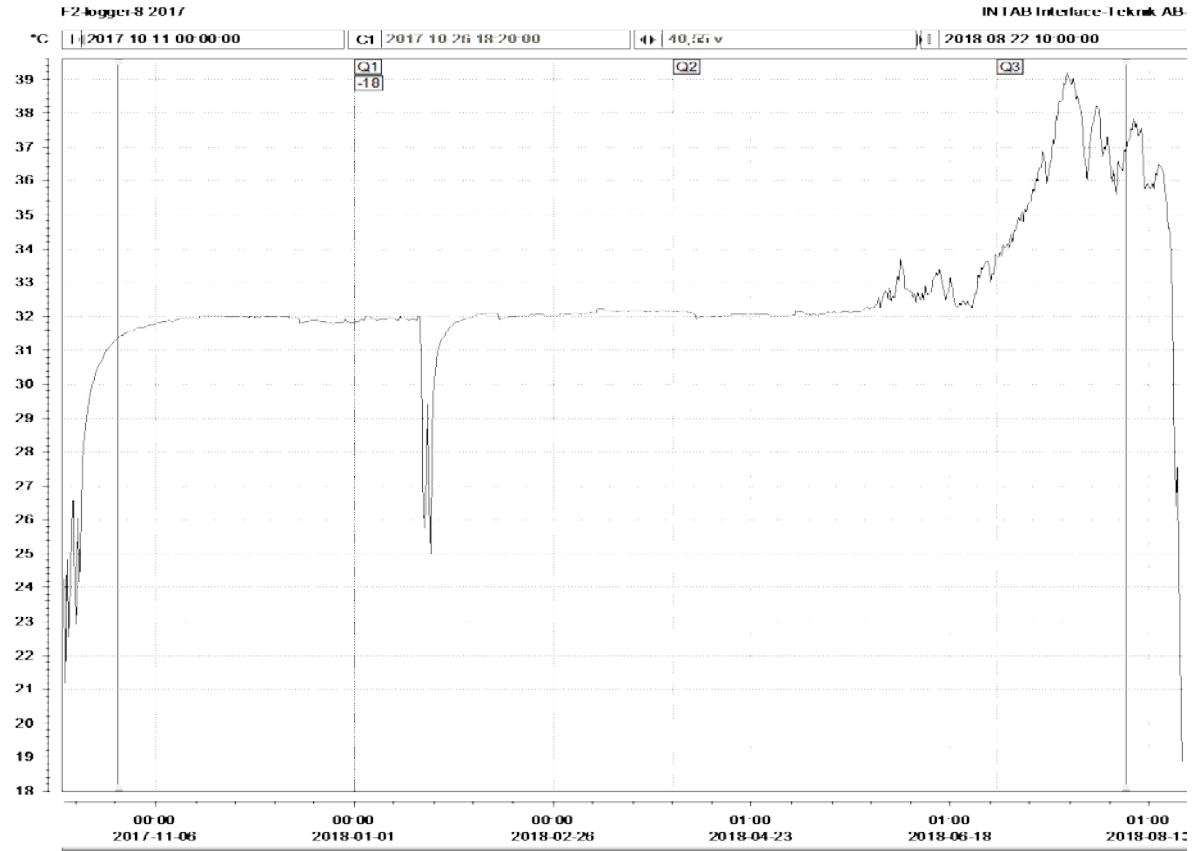
# In the field

- The temperature loggers are normally placed in different locations each year.
- Placing of the loggers is determined by inspection, walk down and need of requalification data.
- The loggers are tied to structures or components with steel wire.
- Every logger placement is documented in a report and with camera.



# Results

Max temp.: 39,17  
Avg. temp.: 32,45



# HOW WE USE THE RESULTS

# Documentation

- Temperature measurements is compiled in a yearly report which is distributed to engineering, operations and maintenance department.
- Deviation reports are made for any larger issues discovered during IR-camera inspection.

# Value for qualifications

- The engineering department can use the reports for:
  - Qualification of new equipment
  - Re-qualification of old equipment
  - Re-assessment of qualification reports
- The maintenance department can use the reports for:
  - Optimise aging management maintenance
  - Re schedule measures if local hot spots have occurred

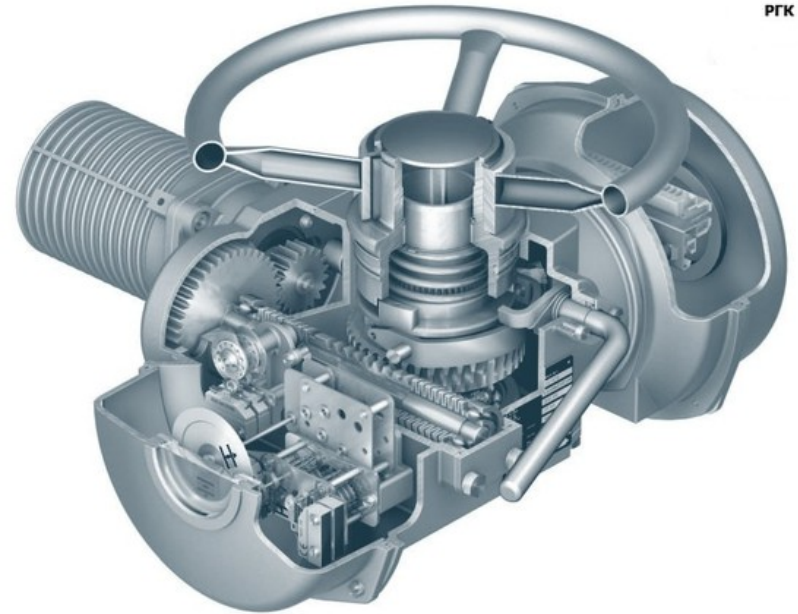
# Re qualification examples

- Cable penetrations, inside containment
  - Nominal ambient temperature 55 °C
  - Actual ambient temperature 50 °C
- Testing are completed 2018
  - Result from the testing: 20 years service life in 50 °C ambient temperature.
  - Results from temperature measurements gives a service life of 34 years in an ambient temperature below 46°C. (Arrhenius)



# Re assessment

- Valve actuators (MOV)
  - Nominal life span 20 years
  - After re assessment 30 years
  - Basis for the new conclusion was that the qualification temperature was 60 °C and the actual ambient temperature is 50 °C



РГК Папиор



# Qualification new equipment

- In the qualification process we always aim for the TBE demands, if the tests fail new tests can be made based on the actual ambient temperature.
- If we use the actual temperature there might be limitations in the use of the equipment.

# Maintenance measures

- If deviations is discovered that can affect the safety functions a corrective maintenance work order is made
  - Example: bad insulation on a valve caused the temperature on the cables to exceed 80 °C. The cables was replaced and tested.

# Questions?

