ENSREG National Action Plans Workshop

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SÚJB

Outline

- Overview of the NAcP revisions
- Main changes in the NAcP since 2013

- Progress in implementation of the NAcP
- Outcomes of studies and analyses

- Lessons learnt
- Conclusion

- Responses to received questions

NPP sites


SPÁLOV
ÚSTÍ NAD LABEM – STŘEKOV
LEDVICE II, III
ÚSTÍ NAD LABEM
POŘÍČÍ II
LES KRÁLOVSTVÍ
NOVÝ HRÁDEK
TUŠIMICE II
POČERADY
PRUNÉŘOV I, II
ŽELINA
KARLOVY VARY
MĚLNÍK II, III
MĚLNÍK
OBŘÍSTVÍ
PRAHA
DVŮR KRÁLOVÉ NAD LABEM
PŘEDMĚŘICE NAD LABEM
HRADEC KRÁLOVÉ
HRADEC KRÁLOVÉ
PASTVINY
DLOUHÉ STRÁNĚ I, II
PŘELOUČ
PARDUBICE
PARDUBICE
DĚTMAROVICE
OSTRAVA – VÍTKOVICE
OSTRAVA
TISOVÁ I, II
CHVALETICE
PRÁČOV
HRACHOLUSKY
PLZEŇ – BUKOVEC
PLZEŇ
VRANÉ
ŠTĚCHOVICE I
ŠTĚCHOVICE II
SLAPY
KAMÝK
ORLÍK
DALEŠICE
MOHELNO
ZLÍN
BRNO – KNÍNIČKY
BRNO
SPYTIHNĚV
ČERNÉ JEZERO
KOŘENSKO I
KOŘENSKO II
ČEŇKOVA PILA
VYDRA
TEMELÍN
HNĚVKOVICE
BRNO – KOMÍN
DUKOVANY
DUKOVANY
HODONÍN
VESELÍ NAD MORAVOU
ČESKÉ BUDĚJOVICE
LIPNO I, II

NPPs in the Czech Republic - Dukovany

4 VVER 440 reactors (type V-213) with power 1 375MWt, resp. 1 444MWt
The units were put into operation in the years 1985 to 1987

Current operation Licenses are valid till 2015 - 2017 - deadline for all measures

Current PSR period deadline - 2015

NPPs in the Czech Republic - Temelín

2 VVER 1000 reactors (type V-320) with power 3 000 MWt
The units were put into operation in the years 2000 to 2002
Current Licenses issued in 2010/2012, valid till 2020/2022
Last PSR results reported in 2010

Overview of the NAcP revisions

- **NAcP, Revision 0**
  - December 2012
  - ENSREG specifications defined in 2012
- **NAcP, Revision 1**
  - July 2013
  - Prepared to reflect:
    - outcomes of the 1st ENSREG NAcP Workshop in April 2013
    - results of a detailed analysis of ENSREG documents since the NAcP, rev. 0
  - Main changes:
    - links between recommendations and actions refined (issue identified in Rapporteur's report 2013)
    - several actions added
    - implementation status of actions updated
- **NAcP, Revision 2**
  - December 2014
  - ENSREG 2nd NAcP Workshop 2015 – Information Pack

Main changes in the NAcP since 2013 (1/2)

- **Additional measures**
  - 8 measures were added (already in NAcP, rev.1)
    - SAMGs for long-term activities
    - Additional fire trucks for multiunit events
    - MCP seals tightness in SBO
    - Procedures for use safety grade DGs in SBO
    - Heat removal from SFPs without water make-up (feasibility study)
    - Containment isolation in SBO
    - Comprehensive analyses of flow paths
- **Measures removed or modified**
  - No measures were removed
  - Action 50 (long-term maintaining of containment integrity – Temelin NPP) have been specified on the basis of analyses performed (Action 49)
    - Implementation of ExVC strategy (deadline in 2022)
    - R&D of IVR strategy for VVER-1000, implementation if feasibility demonstrated
    - Development of strategy of containment heat removal

Main changes in the NAcP since 2013 (2/2)

- **Changes in schedule**
  - Action 12 (Development of a guidance on natural hazards assessment and a guidance on assessment of BDB margins and cliff-edge effects) – postponed (2013 -> 2015) – international actions being performed under umbrella of WENRA and IAEA
  - Other measures are being implemented as scheduled

Progress in implementation of the NAcP

National actions

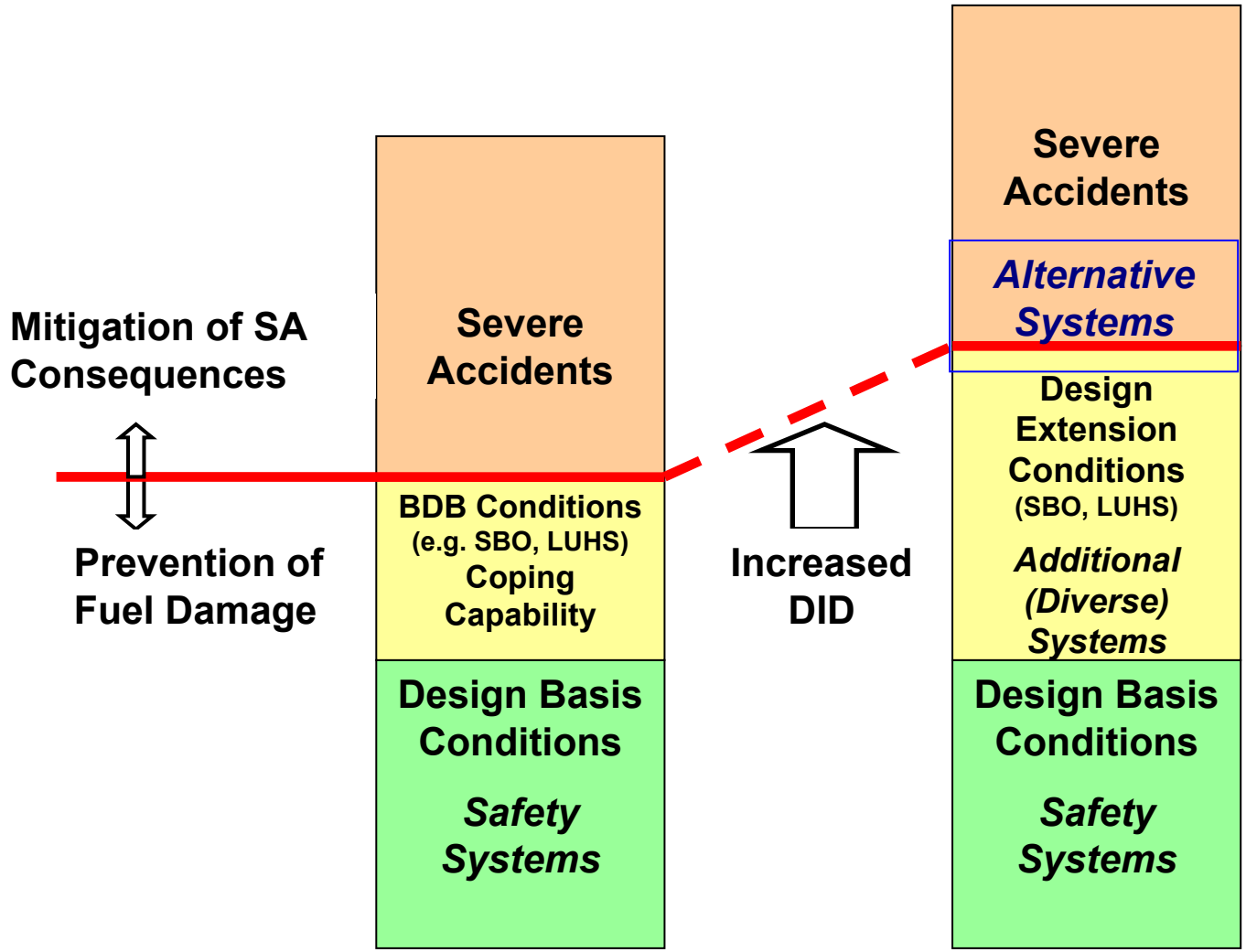
- Amendment of the nuclear legislation (Atomic Act + Decrees) – in force since 2016
  - Reference documents – WENRA 2014, IAEA, 2014/87/EURATOM
- IRRS performed in November 2013
- Transparency
  - NAcP published on SUJB website
  - conclusions of SUJB interim inspections published in SUJB annual report

Actions by licensee

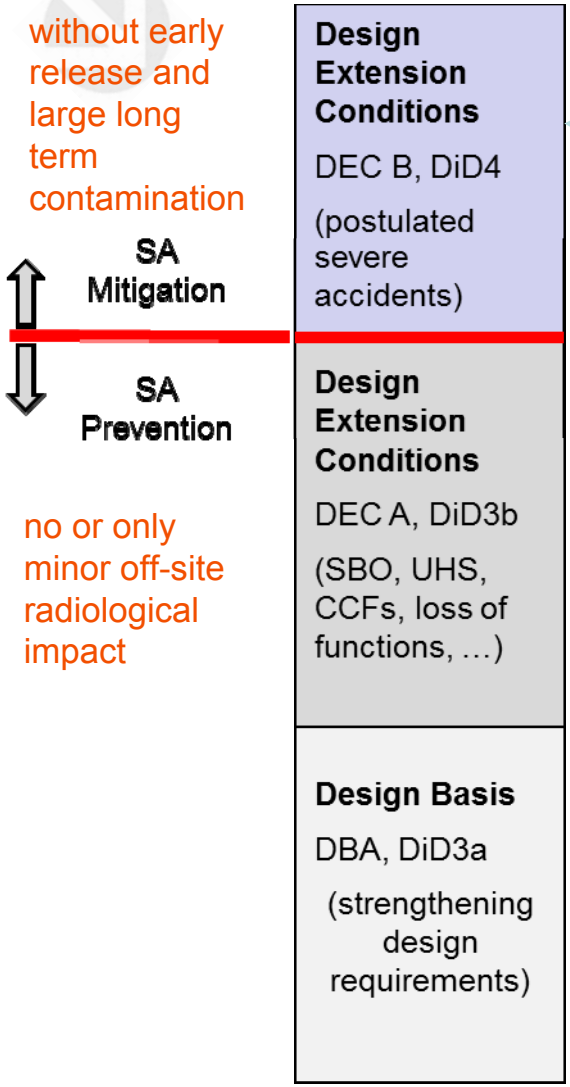
•SÚJB is monitoring status of respective actions in detail

- Periodic reporting on progress in implementation of the NAcP (required by chair letter)
- Regular meetings – presentation/discussion of measures/actions – philosophy, design specifications, detailed schedules of implementation, progress of analyses, progress in updates of documents and organizational measures
- Implementation of measurers is verified within SÚJB inspections

Philosophy of Actions



POST Fukushima „hard“ measures



Severe Accidents measures – SA phenomena mitigation
- enlarged capacity of passive catalytic recombiners
- corium in vessel retention – EDU
- long term containment integrity (IVR&ExVC, overpressure, heat removal)

Alternate measures – additional measures extending design features
- alternate methods for key parameters monitoring
- alternate (mobile) means for fluid charging and power supply
- alternate diesel supply (mobile cistern) for long term DGs operation
- alternate ADGs and handheld power sources (300 kW to 3 kW)
- alternate communication, information and warning means
- alternate emergency centers (mobile)

Back-up (diverse) measures – origin design philosophy extension
- back-up make up (SGs, depressurized reactor, spent fuel pools, containment)
- back-up power supply – additional SBO DGs (4 MW)
- back-up for communication (switchboards, radio network, other. Means)
- back-up emergency centers, sheltering, security and personnel hinterlandd

Basic measures – in line with design basis / strong robustness
- structures protection against extreme hazards (seismic, precipitation, ..)
- adding 3rd EFWP (to ensure 3 x 100% philosophy) – EDU
- independent ultimate heat sink (ventilation towers) – EDU
- filtered ventilation for main & emergency control rooms – EDU
- radiation monitoring parameters in PAMS – EDU

Implemented measures natural hazards – Topic 1

Seismicity

•Dukovany NPP

- Safety related structures reinforcement (PGA = 0,1g)
- Installation of seismic monitoring system

•Temelín NPP

- Fire brigade building reinforcement

Other external hazards

- Regional weather forecasts and predictions for the shift engineer
- Hardening against flooding (diesel generators, emergency control center, entrances to cable trays)
- Fire brigade: additional heavy trucks to remove debris, tank trucks (cisterns), hose tracks, mobile pumps, etc.
- Dukovany NPP - new cooling towers (extreme winds) – relates to Topic 2 as well

Documentations/Analyses/Staff Training

- Risk evaluation from induced floods (PSA)
- Procedures to manage extreme weather conditions

Reactor building reinforcement and seismic monitoring

Implemented measures design issues – Topic 2

- Hardening/improvements of existing systems
  - CR/ECR habitability during design basis accidents (Dukovany NPP)
  - SFP parameters monitoring – PAMS upgrade (Dukovany NPP)
  - Batteries capacity real load testing (design – 2 hrs, reality – 9 hrs)
- Diverse systems
  - SBO DGs (additional stable AC power source, recharging of batteries)
  - Back-up water supply into SG from external sources (Temelín NPP)
  - Back-up coolant supply into depressurized reactor and storage pools
  - Back-up power supply of Security Technical Systems (Dukovany NPP)
- Alternate (mobile) systems
  - Mobile DGs, pumps
  - Alternate monitoring of key parameters
  - Alternate fuel filling for long term operation of DGs
- Documentations/Analyses/Staff Training
  - New/revised documents/procedures for use of new/upgraded systems
  - Capacity and expertise of on-site personnel for multi-unit accidents
  - Off site technical and professional support

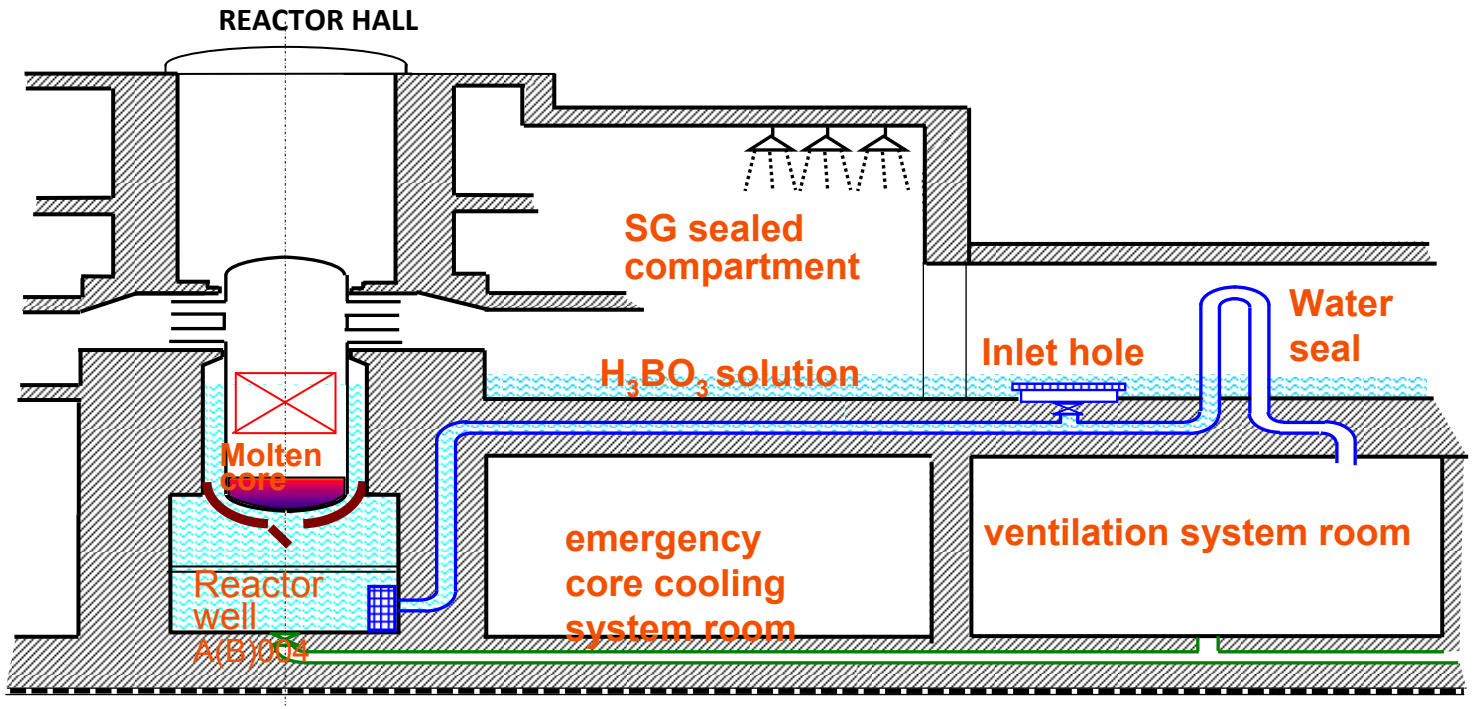
Diverse and alternate power sources

Alternate monitoring and communication

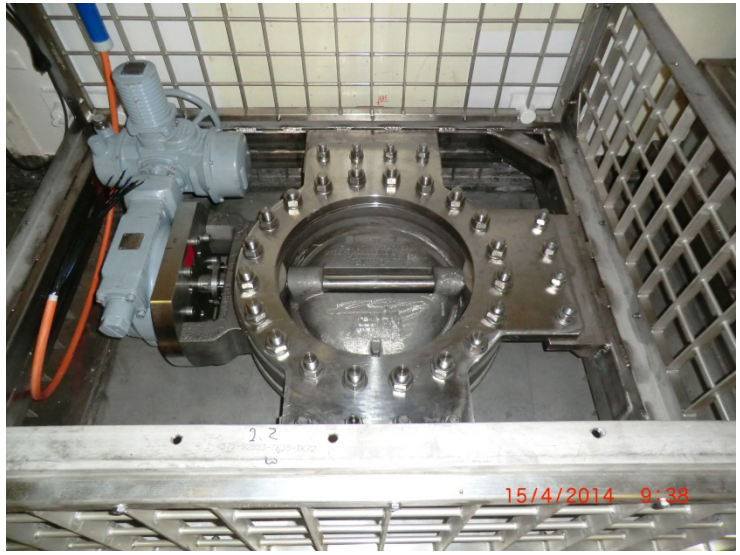
Implemented measures severe accidents – Topic 3

- IVR: external RPV cooling (Dukovany NPP)
- Verification of the equipment functioning during beyond design conditions
- SAMGs for shutdown conditions and SFPs development
- AM procedures and guidelines verification and validation
- Drills, exercises and training for severe accident management
- Back-up power supply for shelters, ECC/ TSC (Dukovany NPP)
- Alternate communication means (wired, satelite phones, bullhorns, …)
- Off-site back-up Emergency Control Centers/ Technical Support Centres
- Physical Protection (Security) / Fire protection Back-up Control Centres
- Personnel and equipment protection during site isolation

IVR measures (Dukovany NPP)



IVR measures (Dukovany NPP)



Outcomes of studies and analyses

Temelín NPP: Long-term containment integrity (corium stabilization, protection against over-pressurization)

- Ex-vessel cooling of the corium (ExVC) is an feasible strategy for stabilizing the corium while maintaining containment integrity
- Implementation steps for ExVC strategy success were defined
- Necessity of installing a filtered venting to ensure long-term integrity of the containment due to the release of non-condensable gases generated during ExVC has not been confirmed
- Analytically demonstrated that long-term control of pressure (heat removal) in the containment is possible using design, diverse or alternative systems

For application of IVR strategy basic analytical research must be completed, large scale experiments must be conducted and complex design modifications on the surface of the RPV, in the reactor cavity and inside the containment must be developed and designed.

Lessons learnt

- **Challenges**
  - Development of a comprehensive system of measures backed up with certain philosophy supporting defense in depth concept
  - Design, procurement and installing of new equipment and other hardware modifications in due times because of tough deadlines

- **Good practices**
  - The deadline for majority of the actions was set by the end of 2015, i.e. before the license for the Dukovany Unit 1 LTO would be granted. The same deadline was set for Temelin units
  - The measures implemented within NAcP are being included into SUJB oversight process

Conclusion

- NAcP has been modified twice since 2012
- Almost all measures are being implemented as scheduled
- Comprehensive system of measures is backed up with philosophy supporting defense in depth concept
- SÚJB is monitoring the status of respective actions of NAcP in detail (reporting by licensee, communication, inspections)
- Since the NAcP is considered living document, relevant conclusions from this meeting will be considered

Responses to questions

Questions - summary

- In total: 65 question + 1 comment
  - Topic 1: 15 questions
  - Topic 2: 15 questions
  - Topic 3: 29 questions
  - General: 6 questions

- Received from 8 EU countries + Ukraine, public, Greenpeace, JRC – IET

Responses to questions - Topic 1

- Extreme weather conditions calculated for 10E-4/y return frequency (regional meteorological data used, calculation of Gumbel distribution).
- Reinforcement and upgrading program for safety related components at Dukovany against seismic hazard at Dukovany (PGA = 0,1 g) already completed.
- Reinforcement program for safety related structures at Dukovany to withstand extreme (10E-4/y) weather and seismic conditions will be completed for Units 1,2 in 12/2015, for Units 3,4 in 5/2017.
- Reinforcement of Temelin fire brigade building to withstand extreme (10E-4/y) weather and seismic conditions – already finished.
- Reinforcement of Dukovany fire brigade building to withstand extreme (10E-4/y) weather and seismic conditions – will be finished in 2015.

Responses to questions - Topic 1

- Site seismic hazard for Temelin was revalidated in 2014 to confirm that sufficient margin exist to safe shutdown limit SL2 value = 0,1 g (100 cm/s2)
- PGA value corresponding to return frequency 10E-4/y is 65 cm/s2 with 95% confidence (HCLPF value)
- Site seismic hazard evaluation for Dukovany will be finalized in the mid of 2015 (reflecting new information released within Share project in 2013). Preliminary results indicate that currently valid PGA (60 cm/s2, return frequency 10E-4, HCLPF value) will remain valid for Dukovany site after 2015.

Responses to questions - Topic 1

– Post Fukushima measures:
  - back up SSCs with increasing margins (50% higher for seismic, 20% for other natural efects)
  - mobile and flexible (alternate) means can be used to maintain plant safety functions
  - specification for the alternate means use different criteria (location, diversity, mobility, etc.), storage in different locations at site (dedicated shelters = transport containers)

Responses to questions - Topic 2

Station blackout:

–regular drills performed with the grid operator to set off dedicated 110 kV or 400 kV lines in order to bring the power to respective site from the back up sources ("black start" enable hydrogenerators)

–any off-site power connections reinforcement are not proposed in the Czech Republic (plant long term SBO strategies do not rely on off site power)

–batteries capacity real load tests (origin design capacity 2 hours)

- Dukovany: performed 9.3.2014, capacity confirmed for minimum 12 hours
- Temelin: performed 19.7.2014, capacity confirmed for minimum 9 hours 20 min

–in both cases sufficient time exist to deploy / align back up recharging from the SBO DGs or alternate charging from the mobile DGs

–dedicated intervene groups (manipulating mobile and flexible equipment) are regularly trained to prove timely actions

Drills for use of mobile means

Responses to questions - Topic 2

Ultimate heat sink:

–Both primary and alternate ultimate heat sink is the atmosphere for both Czech plants

–Primary strategy: essential cooling water system (safety grade, 3 x 100%) transferring the heat from the fuel / systems to the atmosphere

–Alternate strategy: SG feed and bleed (dumping steam from the SGs to the atmosphere while feeding SGs with external water sources)

–No natural water resources (seas, lakes, rivers, ...) with sufficient capacity to absorb residual heat from the reactors in close vicinity of the sites.

–No plans to built any artificial reservoirs as ultimate heat sink

New ventilator towers at Dukovany (issue with separation between ECW and SCW):

–Qualification for extreme conditions

–Configuration: 3x100% for twin units (one unit post LOCA cooling, second unit normal cooling down to shutdown)

–ECW pumps and ventilators in tower energized from respective safety buses, SBO DG can be connected manually to any safety bus of any twin unit.

Responses to questions - Topic 2

Other safety functions - back up means:

–coolant supply into depressurised reactor and storage pools

–use of existing sources of borated water, new tanks were not added

–different tanks can be interconnected to the suction of new pumps (at Temelin), discharge join existing injection lines (LHI, spray, …)

–water supply into SGs (external water sources via outside hook-up points to dedicated lines)

Other safety functions - alternate means:

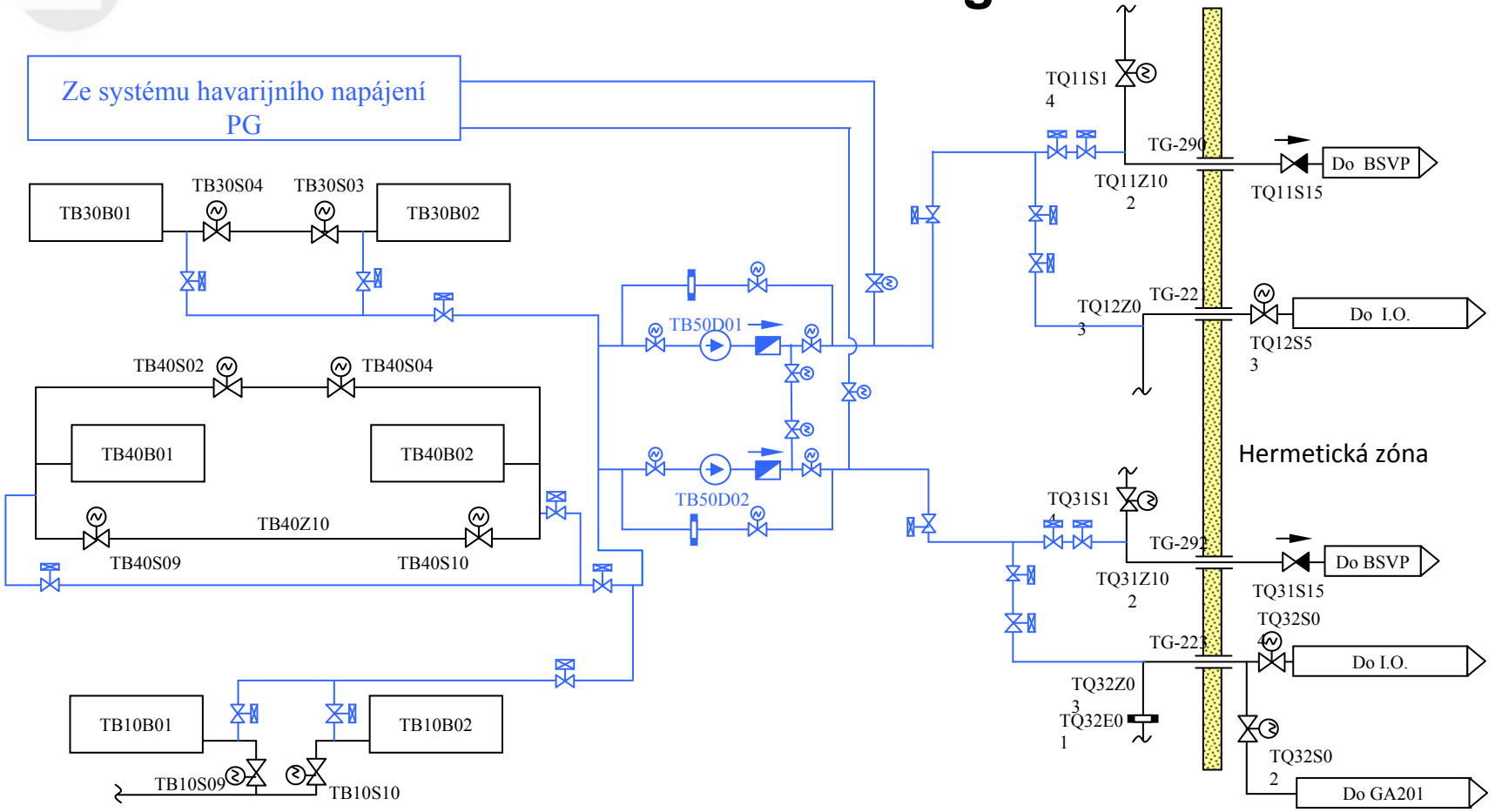
–water supply for CTMT heat removal and CTMT flooding from external water sources

–flexible hoses from mobile pumps using flexible connection to selected injection lines

–pumps and respective valves inside CTMT can be controlled by mobile means (mobile DG, mobile valve controls, electro centrals, etc.)

–operating staff and dedicated intervene groups (manipulating mobile and flexible equipment, laying and connecting hoses, as well as manipulating the valves inside the CTMT with dedicated alternate means) are regularly trained to prove timely actions

Reactor/SFPs refilling - Temelín



Responses to questions - Topic 3

Ex-vessel Cooling strategy (ExVC) at Temelín:

–the following back fitting measures will be implemented (scheduled for 2022):

- measures to timely release the corium from the reactor cavity to the spilling area
- installation of barriers to bound the corium on a restricted area (app. 100 m2)
- installation of heat refractory insulation materials to slow down corium progression until its thermal power is lower and water layer on its surface can effectively remove the heat

–detailed design will be elaborated

–refractory insulation materials (modelled during the analyses) same as used for Gen. III. (EPR, AES1200)

Responses to questions - Topic 3

Long term containment integrity – pressure built up:

–Temelín ExVC analyses:

- CTMT flooding by diverse and mobile means in the early phase of SA
- additional contribution of steam production resulting from water-corium interaction (pressure built up after corium release - between app. 8 hours and 2 days).
- containment pressure is at 4.5 bar after 2 days
- deployment of mobile means to start with alternate heat removal
- design bases containment pressure (4.9 bar) not attacked with sufficient margin in long term
- installing a filtered venting to ensure long-term integrity of the containment with ExVC strategy has not been confirmed (event. assuming non-condensable gases releases)

In-vessel Retention (IVR strategy) at Dukovany – already implemented in all four Units

- Analyses of IVR failure consequences are planned to be performed (separately from Slovakia). Issue of steam explosions will be analysed.

Responses to questions - Topic 3

- Re-criticality issue for the correspondent SAM strategies
  - EPRI approach adopted in the SAMG at Czech plants with respect to potential for re-criticality
  - SUJB requires licensee to monitor the R&D on this subject, re-criticality is currently not consider as a high priority issue

- Habitability analyses of the MCR/ECR during severe accidents
  - calculated doses allow to perform timely actions (at least CR SAMGs) during the initial phase of the severe accident to mitigate unacceptable progressions (RCS pressure decrease, prevention of direct CTMT heating, etc.)
  - to further reinforcement of MCR/ECR against severe accident source term at Dukovany (currently resistant against DB accidents and DEC A conditions) control room ventilation isolation mode was adapted and new dose rate measurement was added
  - locations inside reactor buildings (incl. control rooms) may not habitable for long term presence during severe accidents

Responses to questions - Topic 3

– Depressurization of RCS
  - Primary circuit depressurization is one of the main actions requested in the EOPs and in SAMGs. Either PRZR PORV, PRZR SV or emergency gas removal system (YR) can be used for RCS depressurization. Licensee continues to qualify critical measurements and components for severe accident conditions.

– New on-site emergency centre protected against severe natural hazards and radioactive releases
  - No new ECCs will be built. The system of basic (on-site ECCs), back-up (off-site ECCs) and alternative ECCs (mobile ECCs – procured till 2017) preparation has been accepted by regulatory body. The basic ECCs are the existing ones.

– PAMS
  - Meets RG 1.70 requirements for 1E system
  - PAMS monitors located in MCR and ECR
  - Power supply from batteries (can be recharged by the SBO DGs or by mobile DGs)

Thank you for attention