OSART Good Practices
ACCIDENT MANAGEMENT
Plant emergency arrangements with respect to SAM

Temelin, Czech

Mission Date; 5-22 Nov., 2012

Expert system for the evaluation of source term based on accident type and status of barriers against fission product releases (ESPRO).

Radiological consequences caused by fission products releases during severe accidents are calculated using RTARC code and depends on existing source term. Selection of proper source term is an essential condition for timely selection of protective measures based on existing radiological consequences. Existing accident conditions (e.g. rapid and sudden conditions changes, unpredictable evolution) could aggravate evaluation of source term. Old method for evaluation of source term is based on TSC personnel judgment. Expert system ESPRO facilitates evaluation of source term based on existing emergency conditions evolution.

For various severe accidents scenarios types source terms are pre-calculated using MELCOR code. Expert system ESPRO is a tool for on-line selection of proper source term based on actual evolution of accident.

Source term evaluation is based on calculation of dominated effects on release path significantly affecting source term magnitude. Such an approach does not require detail knowledge about fission products release paths and certain source term could be common for various emergency sequences. The decision making process is based on knowledge of crucial systems and barriers status significantly affecting a release paths. This method is based on the following assumptions:

- Limited number of severe accidents conditions significantly affecting severe accident progression;
- Several parameters characteristic for severe accident conditions are identified and documented;
- Variable values of parameters are available on-line during severe accident progression.

Source term evaluation algorithms corresponds to symptom oriented EOPs structure and the evaluation of source term is performed automatically based on on-line data provided by unit information system. If on-line data from unit information system are not available the source term evaluation could be performed manually.

Clinton, USA

Mission Date; 11-28 Aug., 2014

The approach taken to severe accident damage mitigation is based on the uniform response of the Clinton Power Station and the whole Exelon fleet of nuclear power plants.

CPS in coordination with other nuclear power plants in the Exelon fleet decided to harmonize the approaches used and to acquire standard (primary and backup) equipment for each plant of the fleet for mitigation of severe accident damage. Each site having unified mitigating equipment, some of which is portable including unified connections points of cables and hoses, will allow transferring and utilizing the equipment at another site if needed. The approach taken would also facilitate sharing experiences and resources in training and maintenance.

In addition, the Clinton Power station is involved in the establishment of regional response centres equipped with additional equipment available for all NPPs in the country, thus providing a cost effective means for NPP responses to emergencies. The National SAFER Response Center is in an advanced stage of implementation.

Due to compatibility of the means which allows sharing them with other nuclear power plants in the Exelon fleet and with the regional centre, the CPS will be better positioned to effectively deal with severe accidents by more powerful means and for a prolonged period of time. In this way also public trust and confidence is further strengthened.

Flamanville, France

Mission Date; 6-23 Oct., 2014

Nuclear rapid response task force (FARN). Availability to support FLAMANVILLE

The nuclear rapid response team (FARN), set up following the Fukushima accident, is tasked with responding within 24 hours at a nuclear power plant affected by a severe accident in order to limit further deterioration of the situation, prevent large off-site radioactive releases and prevent core melt if possible.

FARN is able to provide support in terms of personnel and equipment resources to a plant affected by a severe accident. The taskforce is set up to allow it to respond to accidents involving several reactors on a single site (currently 2 units, to be extended to 4 units from the beginning of 2015 and 6 units from beginning 2016), regardless of site access conditions. Flamanville can currently be supported by FARN, and modifications (scheduled for completion by the end of 2014) are in progress to install connection points for FARN mobile equipment.

FARN is composed of approximately 300 EdF personnel that are able to transport and deploy major specific resources to a site affected by an accident. FARN is set up at 4 regional bases located at Civaux, Dampierre, Paluel and Bugey power stations, with the headquarters located in the Paris region. Every regional base has 5 teams of 14 persons each, all on call for immediate action within 1 hour. The first FARN team arrives on the site affected by the accident in less than 12 hours and is fully operational within 24 hours.

The FARN members are all nuclear workers who split their time throughout the year between their original specialisation at their NPP and activities specific to FARN. During the periods of FARN duty, the team members dedicate most of their time to training, drills and maintenance of the FARN equipment. In the event of response operations, FARN has essential skills (operational, maintenance and logistics) to assist or take over from the site teams.

The team members deployed for response to an NPP affected by an accident under FARN command have to carry out the following priority actions as dictated by the crisis manager (PCD1) at the affected site:

- provide and connect the emergency response equipment (pumps, emergency diesel generators, fuel tanks and air supply)
- carry out appropriate monitoring of operation of the emergency response equipment and ensure related logistics to guarantee operation, especially fuel supply
- participate in assessment of availability and condition of site equipment
- participate in maintenance of site equipment, to guarantee (or restore) its operability
- support the shift team and ensure targeted handover (assessment of the situation, ongoing and forthcoming actions and status of the safety functions)
- participate in priority operating actions (in support of or to take over from the shift crew), required by the situation and especially unit safety status
- operate vital safety systems (especially the steam dump to atmosphere (GCTa), auxiliary feedwater system (ASG) and station blackout diesel generator (LLS))
- carry out plant alignments
- carry out plant monitoring and checking rounds
- deploy the backup means of emergency response communication.

Flamanville, France

Mission Date; 6-23 Oct., 2014

The keys for mobile emergency response equipment are stored in a key box next to the equipment.

The plant currently has 2 mobile emergency diesel generators, 2 pneumatic mobile pumps and 1 mobile air compressor stored in a seismically qualified location on Unit 2. The keys for the mobile emergency diesel generators are stored in a sealed key box next the area where the equipment is stored. Additional sets of keys are available in the emergency control centre bunker and with the maintenance group.

This measure contributes to the operability of the mobile emergency response equipment in severe accident conditions. For example, in case of an earthquake the keys will remain available given the resistance of the storage facility to earthquakes. This measure will also save time by allowing emergency response teams to go directly to the equipment storage area.

Dampierre, France

Mission Date; 31 Aug.-17 Sep., 2015

Protection against extreme winds and associated missiles.

During the third ten-yearly outages from 2011 to 2014, the plant installed metal nets to protect nuclear safety equipment from extreme winds and associated missiles. The Emergency Diesel Generator radiators have additional concrete protection from falling objects.

Benefits:
- Reduced vulnerability of important nuclear safety equipment, such as the emergency diesel generator and ultimate heat sink, from extreme winds and associated missiles,
- Reduced risk of a severe accident by reducing the probability of loss of all AC Power and the ultimate heat sink.

Dampierre, France

Mission Date; 31 Aug.-17 Sep., 2015

Demarcation of signal zones for Irridium satellite telephones.

The plant introduced systematic demarcation of zones where an Irridium satellite telephone signal is available. These areas are specifically located where signal interference from the cooling towers and buildings is minimised and has been tested by telecommunication experts. These areas are clearly sign posted so that response teams do not lose time searching for them during an extreme event.

Benefits:
- Reduced risk of a severe accident since this communication facilitates coordination of accident mitigation activities and
- Less exposure to radiation in the event of airborne contamination or ionizing radiation by minimising the exposure period.

Bruce B, Canada

Mission Date; 30 Nov.-17 Dec., 2015

Emergency Mitigating Equipment (EME) Strategy for Rapid Response

In the event of a station blackout (SBO), enhancements and new installations have been made which would allow Bruce Power to remove decay heat by providing rapidly emergency make-up water to the secondary side of the steam generators and to the primary heat transport systems and secondary fuel bays as well as to provide power to critical instrumentation and components. Bruce Power was the first utility in Canada to put in place this capability.

Emergency Mitigating Equipment (EME) in the form of independent mobile pumps and hoses, as well as portable diesel generators and cables are stored approximately 2 km from the plant. The storage location would not likely be impacted by an external event which impacts on the plant.

The EME provides multiple barriers to prevent or mitigate a severe accident. Hook-up connection are also provided for injection into heat transport system, calandria, vessel and shield tank, aiming eventually at ensuring in-vessel retention, and thus preventing core-concrete interaction. These arrangements allow the EME to be installed on site within 1 hour after the request for deployment.

Following an SBO, mobile pumps and hoses are deployed to the dry hydrants, which have been installed at the plant cooling water exit. The dry hydrants significantly reduce the complexity and physical effort necessary to connect to the supply. In addition to the mobile equipment, permanent connection points have been installed to allow for connection of mobile pumps and portable power generators.

Three custom built fire trucks have the pump capacity of 650 m3/h. This satisfies the flow requirements for cooling the four reactors and fuel bays. Fire trucks were chosen because the Emergency Response personnel (fire brigade) already use fire trucks and so they are familiar with the operation, maintenance and testing requirements. In fact the new fire trucks are operated on rotation as part of the fleet of fire trucks.




Portable generators have been commissioned for the plant to power critical monitoring instrumentation, the Emergency Filtered Discharge System, and Emergency Coolant Injection System motorised isolation valves during a SBO. The circuit breaker connection points for connecting the portable power generators has been installed and commissioned. There is an additional 400 kW generator to provide emergency power to the Emergency Management Centre. Fuel supply for 72 hours is available onsite.

A procedure has been prepared which defines the process and frequencies, by which EME is periodically inspected, inventoried, operationally checked, and are tested. The duties are taken care by the Bruce Power fire brigade, which works on the 24/7 basis. This

arrangement ensures that the required EME are always available and operationally ready. EME Guides and Standard Operating Guides have been prepared and issued and the required training completed to enable deployment, connection and operation of EME when required. The added benefit of using the fire brigade to transport and connect EME is that burden on operations is greatly reduced so they can focus on managing the plant during emergencies. The only tasks required by operations are to open the valves and to close circuit breakers.

A large-scale exercise was utilized to demonstrate operation of the EME for an extended period of 24 hours, when Bruce Power conducted a five-day large area emergency response exercise called the 'Huron Challenge' in 2012, in cooperation with the Office of the Fire Marshall Emergency Management Ontario, The overall objective of the Huron Challenge was to demonstrate and improve emergency preparedness. The exercise included 22 municipalities and regions, in addition to 27 organizations. The basis for the exercise was a large tornado, which caused a total loss of offsite power (major damage to switchyards) and a total loss of backup power. Bruce Power used the Huron Challenge to validate that it had the capability to manage multiple incidents on-site without outside support for 72 hours.

Cernavoda, Romania

Mission Date; 7-24 Nov., 2016

Software application to estimate personnel dose during the implementation of field response actions.

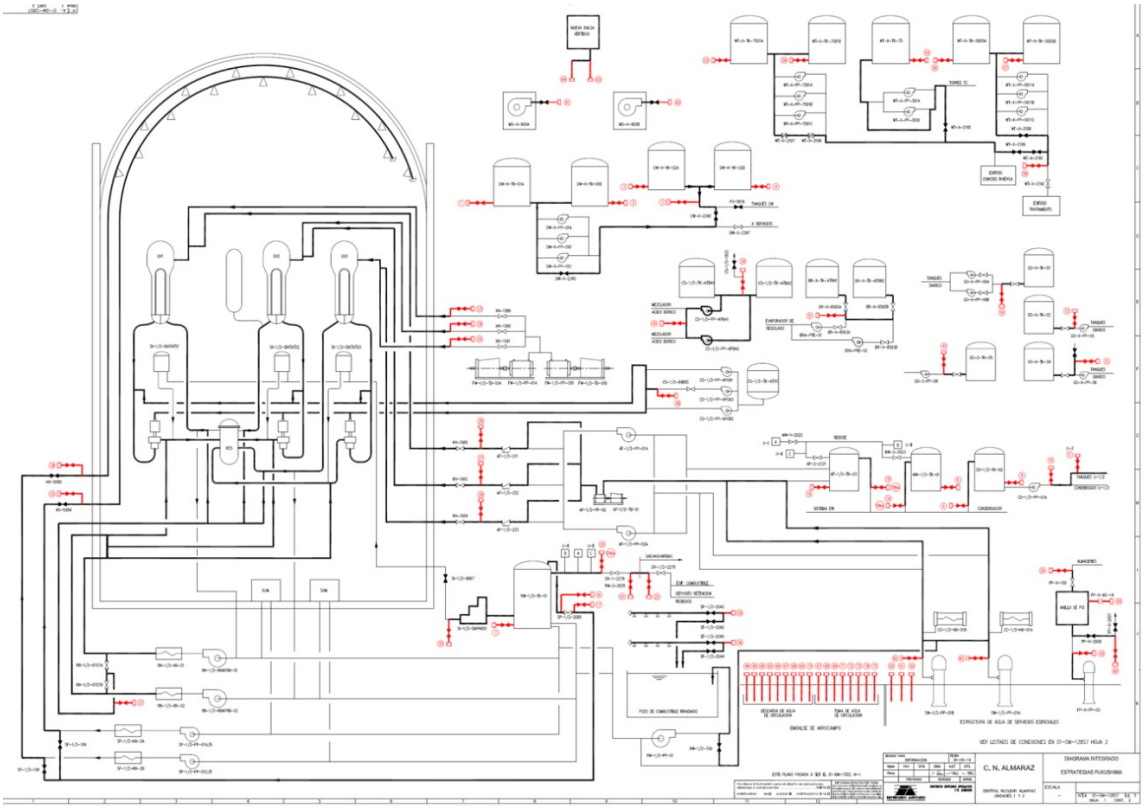
A software application was developed by the plant to estimate the dose that personnel would receive during a severe accident when implementing the Enabling Instructions. The software uses projected radiation fields from a habitability analysis that was performed for Units 1 and 2, and takes into account the anticipated timeline of accident progression. This software application is available to the Emergency Health Physicist in the Emergency Control Centre and can be used if direct dose rate indications on the plant are not available. All Emergency Health Physicists are trained (theoretical and practical training) to use this software application, and the use of the software is tested during routine monthly verifications of the Emergency Control Centre.

Almaraz 2, Spain

Mission Date; 5-22 Feb., 2018

Large number of clearly labelled options for mobile pump deployment.

The plant has installed many clearly labelled suction options (e.g., 11 from the ultimate heat sink & 7 from tanks) for the use of mobile pumps to make-up to the Primary Circuit, Spent Fuel Pool and Steam Generators.



Overview of connections

RCS makeup connection

Pump deployment

Tank connection

Lake connections

Benefits:

- The numerous suction options assist in ensuring successful deployment of the mobile pumps.

- Less exposure to radiation by minimizing the exposure time due to clear labelling.