[Form 2 (to be reported to Committee on Countermeasures for Contaminated Water Treatment and to be disclosed to public)

Technology Information	
Area	4. **Management of contaminated water inside the buildings** **5. Management measures to block groundwater from flowing into the Site**
Title	**Leak Sealing**
Submitted by	**AMEC**

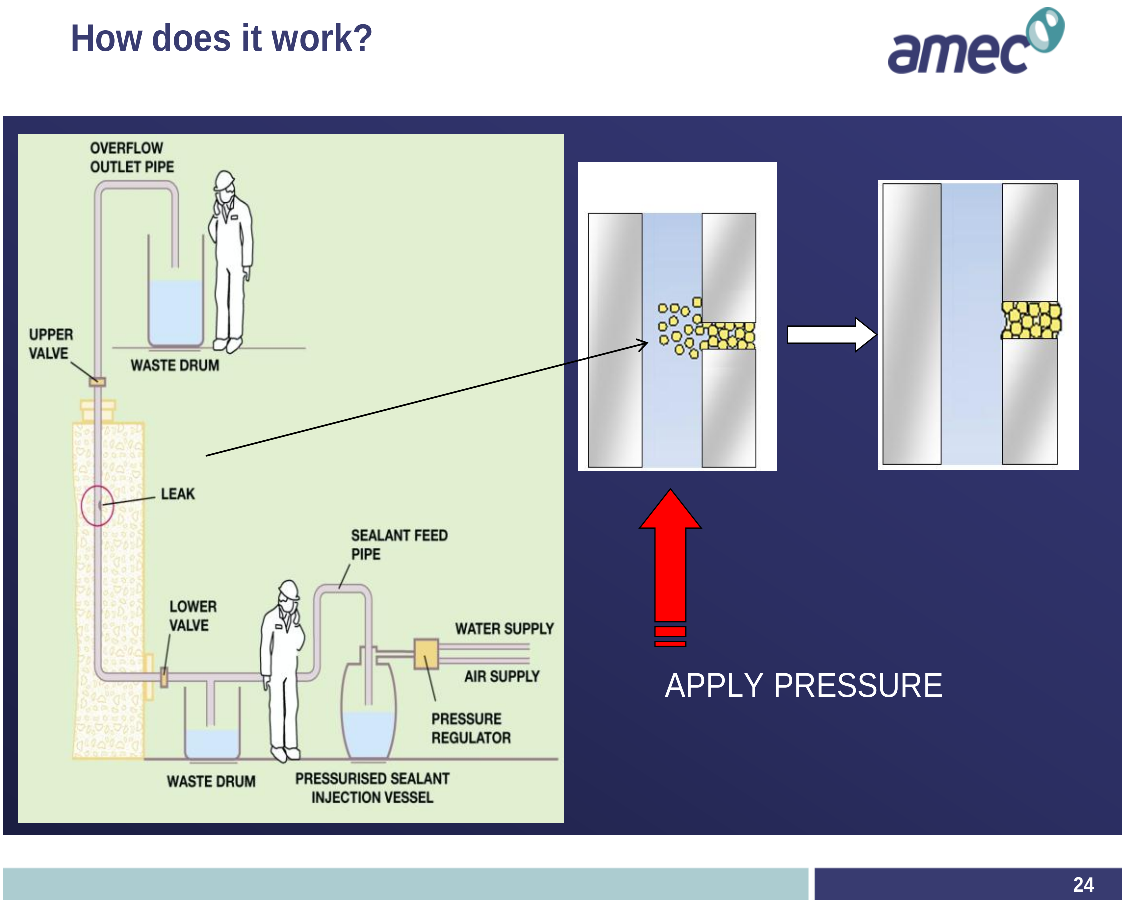
1. Overview of Technology (features, specification, functions, owners, etc.)

AMEC is a world leader in remote leak sealing technology, developed exclusively to remotely plug holes in inaccessible pipework, ponds, cells, etc. It has proven to be effective in sealing over 650 leaks at over 40 sites worldwide (including UK, Canada, Switzerland and India). It's features are:

- Originally designed and developed for the repair of inaccessible pipe leaks, it is a cost effective alternative to replacing simple and complex pipework
- Reduces or eliminates downtime, is highly durable and withstands high pressures
- Resists corrosive environments and is radiation resistant
- Does not adversely affect pipework, valves or instrumentation e.g.: cooling capability maintained - no compromise of heat transfer in cooling systems
- The technology can be applied underwater (including in sea water where temperatures range from temperatures between 5 °C to about 70°C) and at depths under 10m of water, noting each situation is unique and needs to be trialled
- For larger leakage areas a series of patches can be applied e.g. if a crack is at the base of a pond a heavy epoxy resin can be used which hardens and sets underwater
- Can seal leaks in concrete pipes
- Post treatment ensures that all excess treatment material is removed from the system
- Range of products and technologies are available ranging from underwater curing epoxies and very specialised closed cell polyurethane compounds to specialised radiation resistant polyureas.

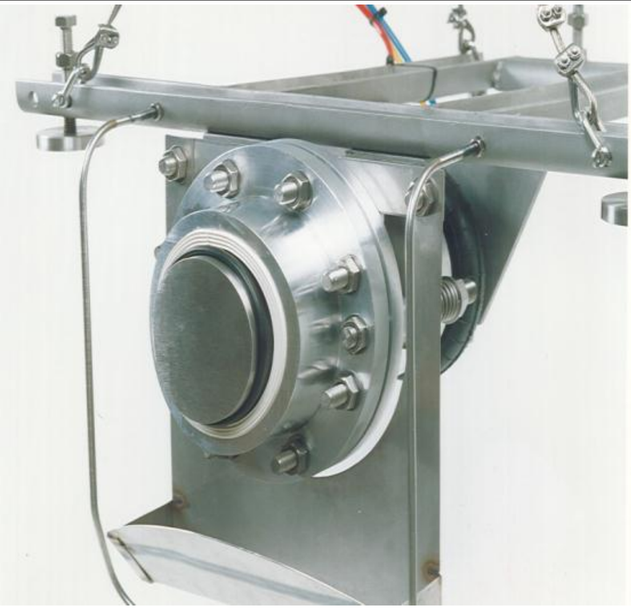
Each time the leak sealing equipment needs to be developed in conjunction with a specialised delivery system which has to be adapted and tested in replicated environments and conditions to optimise and confirm the process. This is especially true where we are trying to minimise dose uptake or where we have to programme robotic delivery systems.

We have successfully applied the technology on a number of the UK's reactors on a regular basis over 20 years and specifically e.g. at Sellafield, Pickering, and the North Carolina State Experimental Reactor.



The leaking pipe is first isolated and emptied. The special sealant mix is introduced into the pipe until it is full and then the pipework is pressurised. Due to the properties of "shear forces and fluid mechanics," the special clay mixture coagulates at the leak site, hardens and seals the leak. The pipework system is then washed with water to remove all traces of clay except where it has sealed the pipe. The system can then be reconnected and brought back into operation.

And for larger areas of leakages in e.g. in ponds, we use remotely operated equipment fitted with patches as shown



2. Notes (Please provide following information if possible.)

- Technology readiness level (including cases of application, not limited to nuclear industry, time line for application)

Fukushima-Daiichi Solutions (Challenges)

With respect to the necessary solutions at Fukushima the primary aim would be to reduce the inflow of ground water to the reactor building basement and into the turbine hall. It is assumed at this stage that the basement floor is intact at present and most of the leakage of groundwater is entering the structure through gaps in the walls at the door and pipe penetrations that link adjacent buildings and are beneath the ground water level. The external cable trench is also a source of leakage of the ground water into the buildings.

A number of possible methods could be employed to deal with this leakage dependent on ease of access and applicability to the desired solution. If the ground water can only enter through the gaps between the buildings it may be possible to block those areas off completely with an impervious layer to stop water ingress from the exterior of the building. This could be achieved by injection of LeakSeal clay or even local freezing which could be re-froze after a seismic event . Alternatively, epoxy resins could be applied to deliver the same result by injection, drilling from the inside of the building into the cavity local to the leak sites. It could also be possible to freeze these areas locally to achieve the same result.

These methods may not offer a long term solution since it is unknown how the land may move in another seismic event but could possibly reduce the burden on collecting contaminated water in the short to medium term. In essence our approach would be:

1. Identify areas of potential leaks where our technology could be deployed
2. Review the exact local conditions, review site plans and formulate strategies
3. Review our extensive list of suitable products; decide which ones are suitable for lab scale trials and what modifications may be needed to provide the required formulation
4. Build a small scale test area to trial the method and products
5. Trial the products and assess the results and confirm optimum solution/product
6. Build larger scale test rig and trial proposed solution to demonstrate feasibility of method
7. Demonstrate to client
8. Fix leak

Project example

This project involved the development and supply of a system to deploy for remote operation in a nuclear fuel plant, whose purpose was the application of pads of specially developed sealant over a crack in the plant wall. This ultimate aim of this work was to prevent leakage of active liquor. Core activities on this project included:

- Testing of sealant to ensure its suitability for use over a range of possible plant conditions;
- Design and development of a heated application pad to deliver the epoxy sealant to the surface, heat the sealant until cured, and peel away leaving sealant behind;
- Design and development of a remote latching mechanism to facilitate remote collection and release of the pad into the active area should this be required;
- Design and development of a compliance device to compensate for any planar misalignment between the manipulator and the plant wall to ensure an even seal;
- Design and development of a control system plus umbilical cable and connections for the remote operation of the application system.

The sealant application system was integrated with the existing manipulator and successfully deployed to site.

- Others (referential information on patent if any)

References

List of sites where leaks have been repaired:

- EDF (Britain's AGR Fleet) Over 700 leaks repaired over 30 years
- Culham UK Jet project
- USA Palasades several leaks repaired
- Canada CANDU reactor 2 reactor sites repaired leaks and TRIUMF particle accelerator,
- Switzerland CERN particle accelerator
- India: 2 CANDU reactors and a Demonstration Fast Reactor
- Sellafield Spent Fuel Storage Pond crack patching
- Paper 'Leak Sealing Inaccessible Accelerator Cooling Systems' – see attached