

The ASVAD valve: first-of-a-kind passive safety solution

ASVAD may only have designed one product so far, but the Spanish company believes this unique valve can fill an important role in the nuclear power industry. In fact, ASVAD are confident that their valve is so special that it will be implemented at every PWR-plant in the world. Indeed, at the recent World Nuclear Exchange (WNE) in Paris, the company's invention was nominated for the Nuclear Safety Innovation Award (SME category).

By Lucien Joppen/David Sear

The World Nuclear Exchange 2021 in Paris was the fitting occasion chosen by ASVAD to launch its Automatic Safety Valve for Accumulator Depressurization, or ASVAD for short. At first glance this product may look like a standard safety valve, yet ASVAD are confident that, given its unique capabilities, the valve will be implemented in every Pressurized Water Reactor (PWR) plant around the world. That was very definitely the message which Valve World received when we spoke to ASVAD's CEO, Mr. Laborda, at the WNE. "The ASVAD valve is a genuine novelty and has been specifically designed to solve a problem that all PWRs may suffer during a Loss of Refrigerant Accident (LOCA). During such an event, nitrogen gas from the accumulators may unwittingly be injected into the reactor cooling system pipes. The complications of having non-condensable gases in hydraulic circuits are well documented, so if these circuits are ones that cool a nuclear reactor while it is suffering an accident, the problem acquires a much greater importance since it potentially can put the core cooling at risk.

Passive solution

Asked about solutions currently in place to prevent unwanted nitrogen injection, Mr. Laborda (who just happens to be a nuclear engineer specialized in reactor protection systems) says that utilities currently rely on emergency procedures to isolate or vent the accumulators. "These emergency actions will have to be developed by the emergency organization using the available equipment trying to fix the problem. However, consider a Station Blackout (SBO) like the one at Fukushima, when all the power and all the electric equipment will be lost. It is difficult or even impossible to develop emergency procedures for such situations. Therefore, having an automatic valve which can do all this work could be very helpful to the emergency team."

Mr. Laborda continues: "the ASVAD works automatically in the event that the accumulator loses all its water. In that case, the valve opens and vents the pressurized nitrogen to the atmosphere. This prevents the nitrogen in the accumulator from reaching the reactor pipes. Important to note is that it actuates at precisely the required moment i.e., not too soon (which would result in the loss of the water still available), but not too late (resulting in nitrogen injection into the pipes). This means that the cooling system can be depressurized to lower pressures, greatly facilitating accident recovery.



The ASVAD-valve in its full glory.

The operating principles behind the ASVAD are simple yet elegant, making the valve highly reliable and robust (see box). "A fundamental difference between the ASVAD as compared to standard safety valves is that the ASVAD only actuates when the pressure in the accumulator drops below a pre-set pressure. Its main advantage is that this valve is fully passive and automatic, so does not require power nor any operator action to function. Hence the ASVAD automatically 'knows' the right moment to open based on the prevailing nitrogen pressure inside the accumulator," highlights Mr. Laborda.

Looking for partners

Further discussing the ASVAD, Mr. Laborda states that the uncomplicated design makes for straightforward manufacturing. This simplicity also promotes easy and reliable operation free from wear and complications. Moreover, the ASVAD is intrinsically safe, as it has no electromagnetic issues, is fire proof, radiation proof, water proof, seismic proof and robust against missiles. To date, the ASVAD has already been qualified as Nuclear class 2. During testing, the valve was sub-

Operating principles of the ASVAD

Figure 1 shows a simplified representation of the ASVAD. Features include the pressurized chamber (1) connected to the nitrogen side of the accumulator. This chamber is sealed by a hollow obturator (2) and a gasket. The spring (3) is preloaded by the adjustment disc (4) threaded over the obturator.

The ASVAD's operating principles are based on the imbalance between the forces exerted on the obturator. On the lower side, the accumulator's internal pressure exerts an upwards force on the obturator, keeping it closed (thick arrow). On the upper side, the preloaded spring (thin arrow) exerts a constant downwards force. During normal operation, the force exerted by the accumulator's normal pressure is three times greater than the force exerted by the spring, so the obturator remains firmly closed.

The key to the ASVAD's operation is the spring. It is preloaded to the same force that the nitrogen would exert if the accumulator were to become empty of water. For example, following an accident. In that case, the spring can overcome the upwards force and push the obturator downwards. This effectively opens up the pressure chamber, allowing the nitrogen to escape via holes in the hollow obturator. Once the obturator has moved away from the seat the pressure in the chamber will fall even more, leaving the valve permanently open thanks to the force exerted by the spring. A couple of pneumatic pistons situated inside the valve enables the ASVAD to be opened and closed manually, if required. This manual operation is an interesting option, but is not really needed to fulfil the valve's safety function.

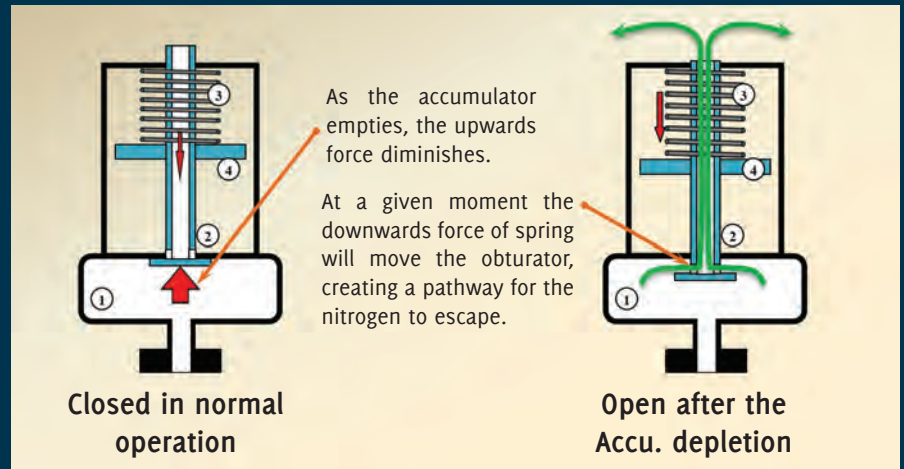


Fig. 1: Simplified operation diagram for the ASVAD.

jected to the ambient effects of the Design Basis Accident (DBA) situation. Temperatures higher than 165° Celsius and pressures to 5 bar were applied to the valve during a period

of several days. After that, the valve worked as expected without showing any damage. Concludes Mr. Laborda: "ASVAD is patent protected across the main nuclear coun-

tries in the world. It is a compact valve measuring 250 mm in diameter and standing just 420 mm high. It is fully made in stainless steel, weighs around 53 kg and can be customized to client specifications. It is available from the Spanish valve builder Ringo Valves, a subsidiary firm of the German SAMSON Group. Right now we are searching for other partners and integrators around the world. We're especially interested to find partners in France, US, Russia, Ukraine, China, South Korea and Japan. We're sure that this valve will soon be the indispensable complement to safety accumulators across all the PWR reactors in the world."

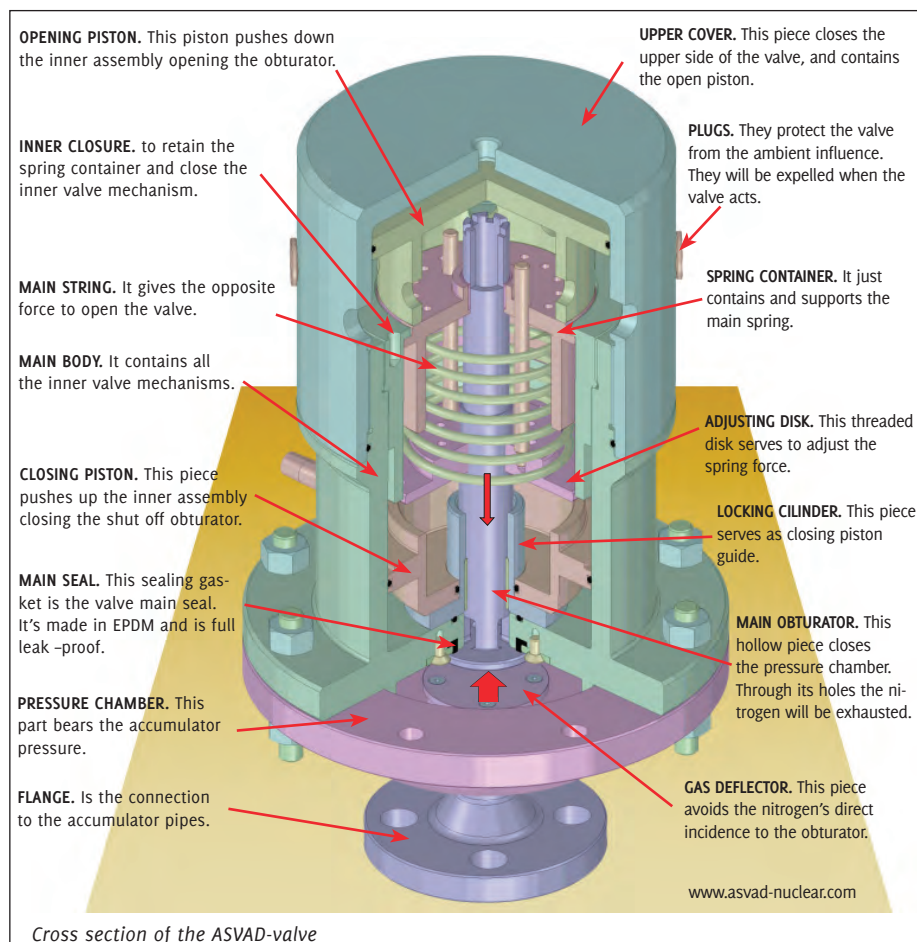


Fig. 2: Internal view of the ASVAD.

Key advantages

- Fully passive – no external energy required
- Fully automatic – no operator assistance needed
- Actuates at the required moment
- Based on universal physical principles (force & pressure)
- Completely vents the accumulator once depleted of water
- Enables the cooling system to be further depressurized
- Does not interfere with normal operations
- Easy installation via a hydraulic connection to the accumulator