ASVAD, A new safety element to avoid the complications of the undesired nitrogen injection to PWR reactors

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During a Long-Term Station Blackout (LTSBO) accident like the Fukushima accident, the main way to remove decay heat from Pressurized Water Reactors (PWRs) is the Steam Generators (SGs). During these accidents, a Loss of Coolant Accident (LOCA) can also occur, as the main pump seals easily degrade without proper cooling. To cope with LOCA, all current PWRs are equipped with 3 or more accumulators. Each one consists of a tank filled with subcooled borated water. These tanks are pressurized with nitrogen to a pressure of around 4.5 MPa. When the primary pressure falls below the initial accumulator pressure, its water is pushed by the pressurized nitrogen into the primary system, increasing the mass inventory and cooling the reactor. **This system has the advantage of being fully passive.**
However, **nitrogen may flow into the primary system once the water has been depleted**. To avoid gas intrusion, the isolation valve must be closed in time. However, this will be difficult to do when there is no power. Then, nitrogen will enter the primary system as soon as the accumulator empties. This nitrogen soon reaches the SG tubes and accumulates in them. Here, **the gas will significantly decrease steam condensation, which is the main method of cooling the core**. This leads to a sudden increase in primary pressure and a strong decrease in natural circulation, threatening core cooling.
To avoid all these complications, a special valve has been designed. **The ASVAD valve is fully passive and automatic**. It automatically vents the nitrogen at the correct moment, when the accumulator empties, preventing nitrogen from reaching the SG tubes. Being fully passive and automatic guarantees its proper operation without any operator action even during LTSBO scenarios. With ASVAD, operators will not be burdened with coping with nitrogen injection and can remain focused on recovery tasks. Allowing further primary depressurization, it can facilitate accident recovery, giving a longer coping time. The overall safety of the PWR reactor can be improved by installing ASVAD on each accumulator.

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