ASVAD

Automatic Safety Valve for Accumulator Depressurization

(p.p.)

THE SIMPLE ANSWER TO A SERIOUS PROBLEM

IAEA
International Atomic Energy Agency

International Experts' Meeting on Strengthening Research and Development Effectiveness in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant

Vienna, 16–20 February 2015

ABOUT THE PRESENTER

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- Working at Asco / Vandellos NPP's (Spain).
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- 50 years old, 26 years in the nuclear world.

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ABOUT THE PRESENTATION

1. Introduction. (2')
2. The Problem: the plant behavior during ELAP accident. (5')
3. The ASVAD element: a unique safety valve. (8')
4. Benefits using ASVAD. (2')
5. Conclusions. (1')
6. Questions & Answers. (2')

WHY ATTEND THIS PRESENTATION?

After this presentation, we will know the answers to these questions:

- What is the Nitrogen Injection Issue?
- What is ASVAD?
- How ASVAD works?
- How ASVAD can help us?

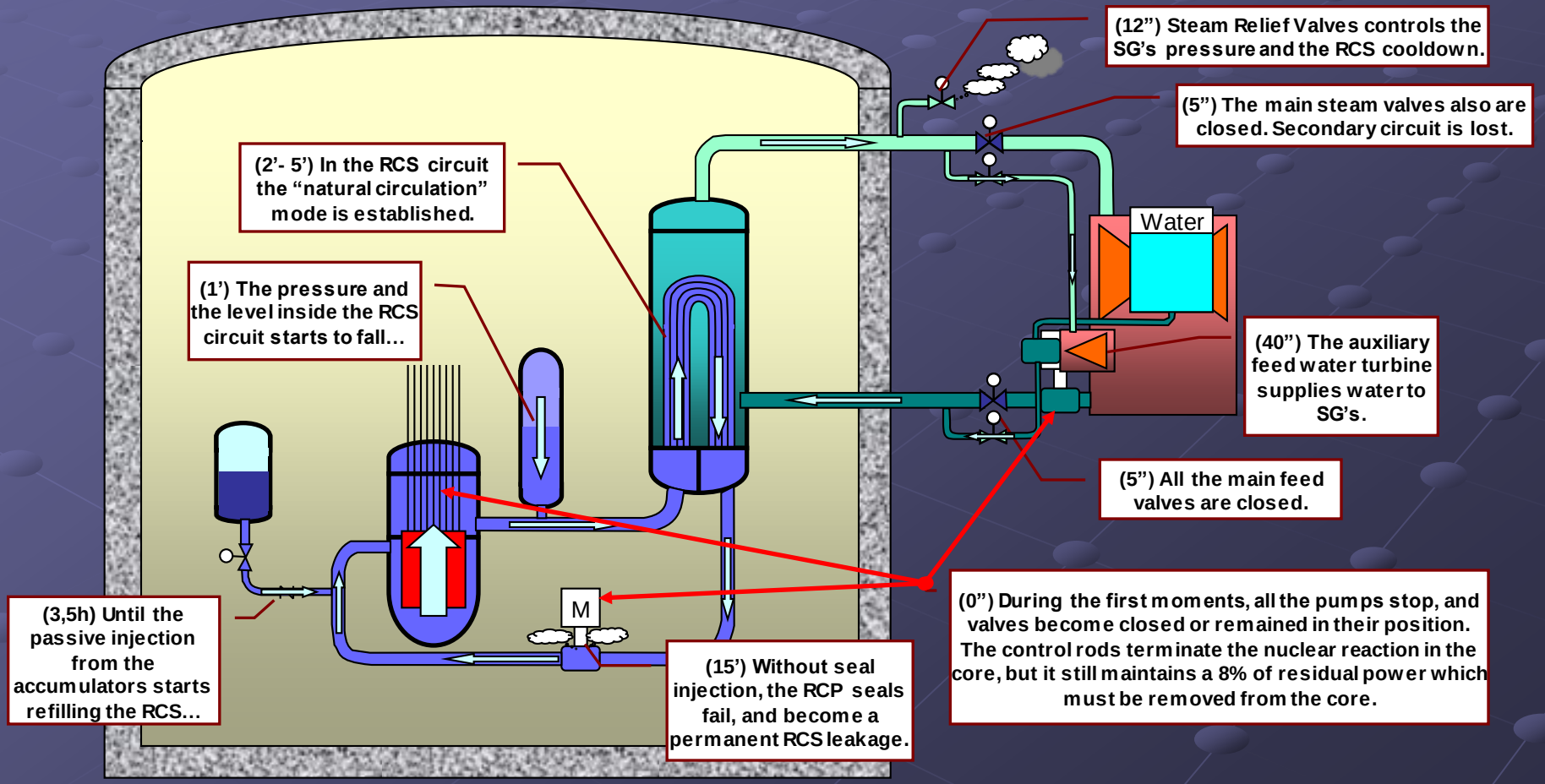
2 THE PROBLEM:

THE EFECTS OF NITROGEN INJECTION INTO THE RCS DURING THE ELAP

- **E**xtended
- **L**oss of
- **A**C (Alternate Current)
- **P**ower

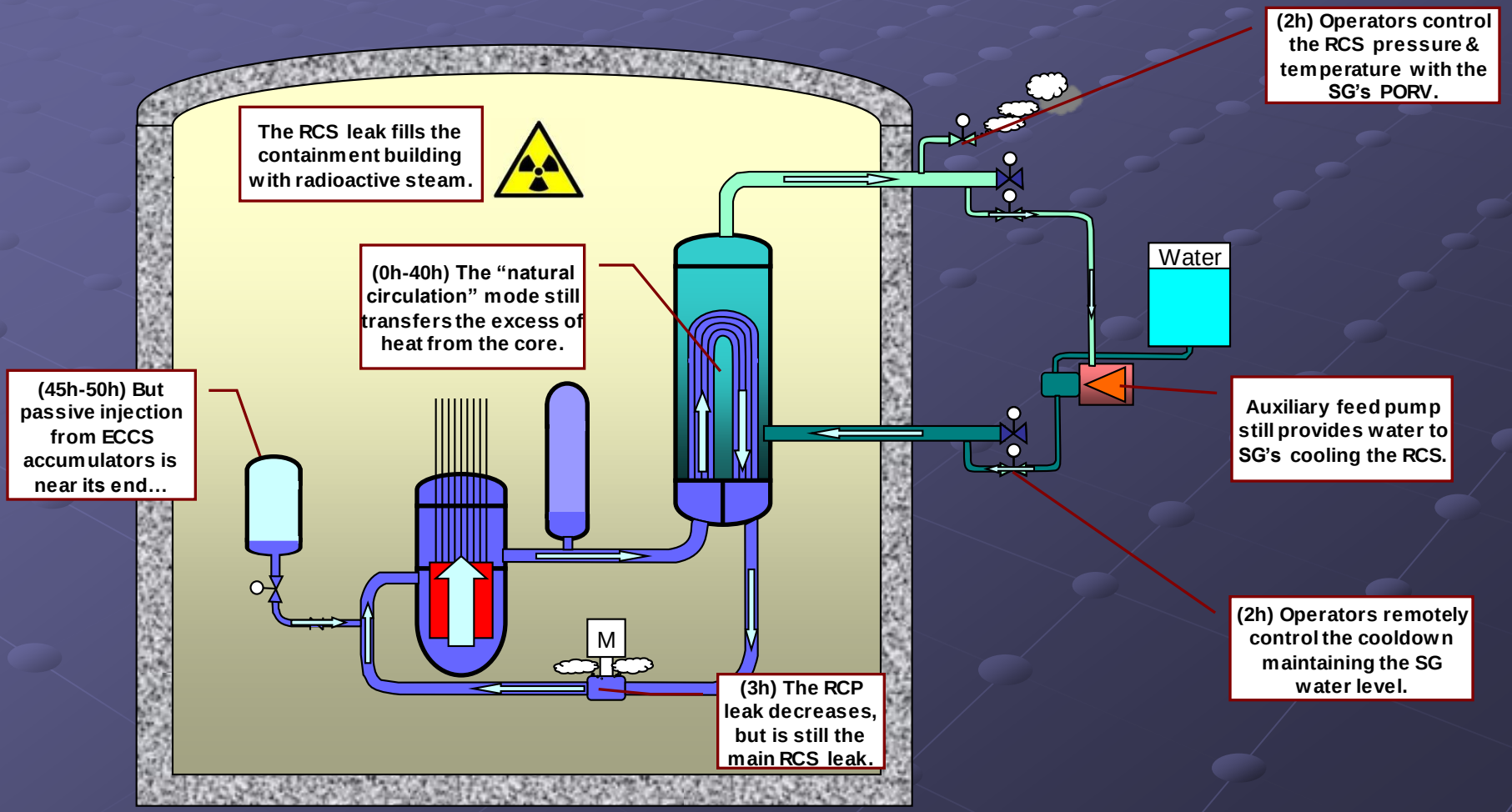
FIRST STAGE: THE ACCIDENT FIRST HOURS

WHAT HAPPENS IN A PWR REACTOR DURING A TOTAL LOSS OF AC POWER EVENT?



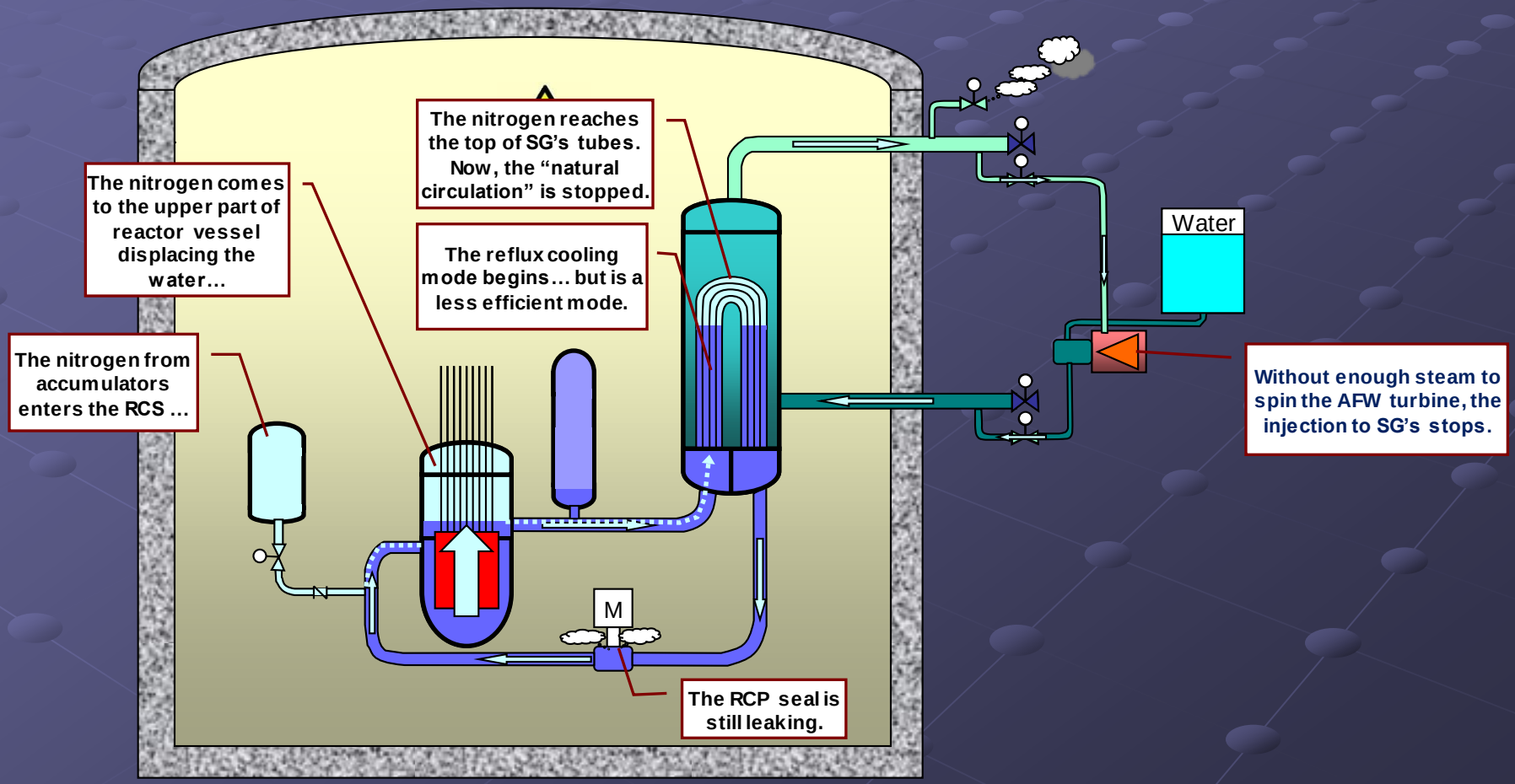
SECOND STAGE: DURING THE ACCIDENT (4h – 40h)

THE MAIN PROBLEM: LOSS OF COOLANT



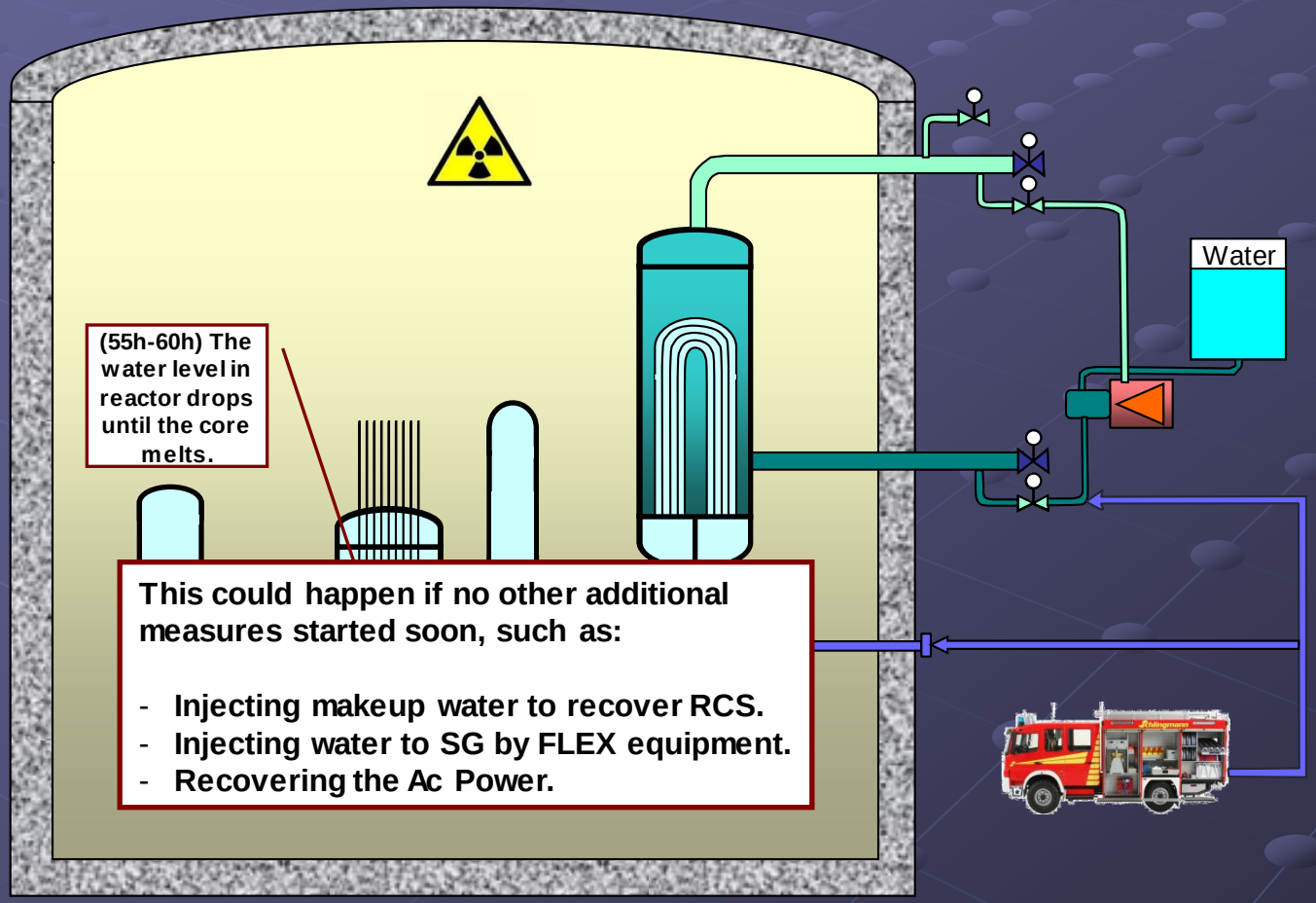
THIRD STAGE: THE ACCIDENT WORSENS (45h - 60h)

THE PROBLEM IS THE NITROGEN INJECTION INTO THE RCS



LAST STAGE:
CORE MELTING (55h – 60h)

WHITOUT COOLING, THE CORE MELTS…
UNLESS ADDITIONAL MEASURES ARE TAKEN.



HOW AVOID THIS?

TO AVOID CORE MELTING WE MUST :

- Maintain the level/pressure in the secondary side of Steam Generators (Water Injection to & Steam Removal from SG).
- Maintain the coolant inventory and pressure in the Reactor Coolant System (Water Injection to RCS).
- Avoid nitrogen injection into RCS. FLEX ?

FLEX EQUIPMENT

Avoiding nitrogen injection into the RCS is a critical safety task, because the nitrogen gas can disrupt the natural circulation process.

Even in the case you can recover the power again, this nitrogen will continue inside the pipes heavily disturbing the core cooling.

It also contributes to the core uncovering, which further challenges the capability to provide core cooling.

HOW NITROGEN INJECTION ISSUE CAN BE AVOIDED?

- Closing the Isolation Valve in the accumulator outlet pipe.
- Venting the nitrogen to the containment atmosphere.
  - This **is impossible to do** without AC power.
  - And even with external energy, operators have to be ready to perform **at the correct moment**: Not too soon (to avoid loss of injection water), and not too late (nitrogen injection into RCS).
  - It must be done **at the same time** in ALL the accumulators, and possibly also in the rest of the units at the site. (Operators will be heavily burdened.)

ASVAD is a NEW ELEMENT that allows the exhaust of the residual nitrogen from the accumulators…

Without the above problems!!

3 THE ASVAD

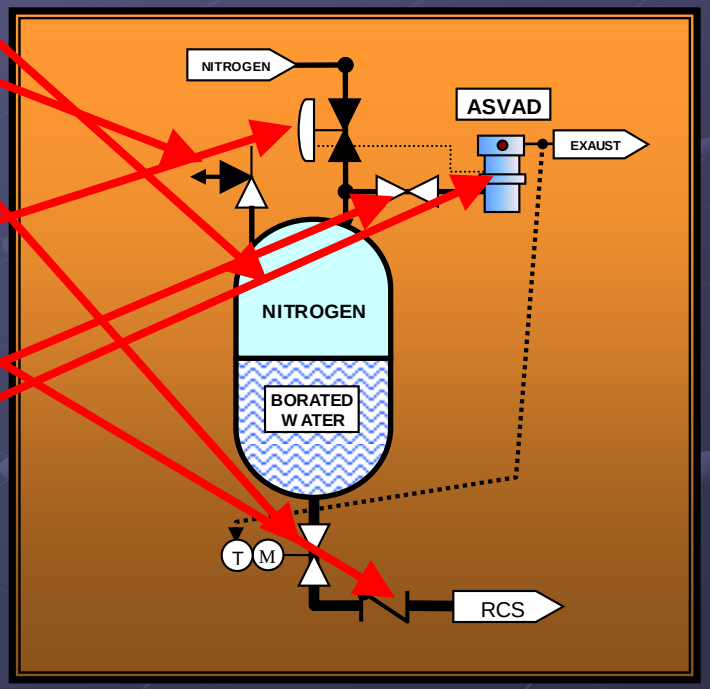
THE SIMPLE SOLUTION TO THE NITROGEN INJECTION ISSUE

- **A**utomatic
- **S**afety
- **V**alve for
- **A**ccumulator
- **D**epressurization

HOW ASVAD IS INSTALLED?

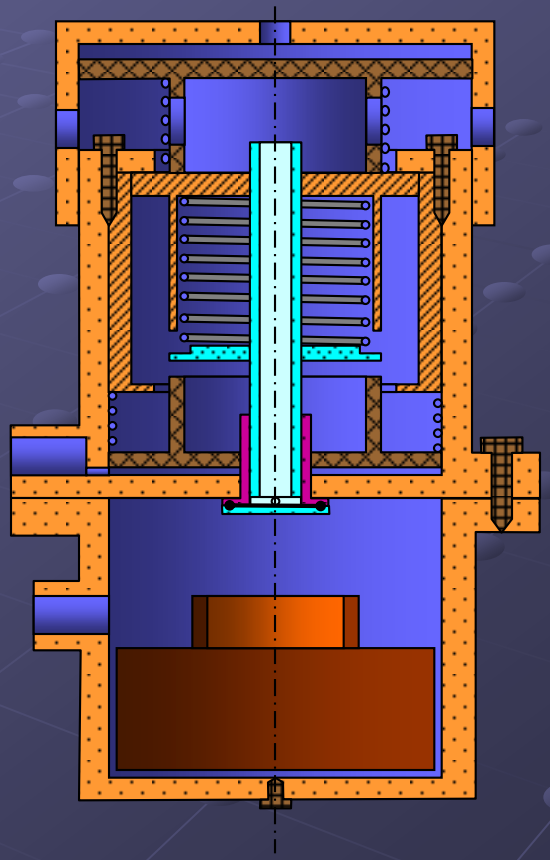
STANDARD INSTALLATION

- Accumulator Vessel.
- Safety Relief Valve.
- Outlet Isolation Valve.
- Non-return Valve.
- Inlet/Vent Valve.
- Manual Isolation Valve.
- The ASVAD Valve.



WHAT IS INSIDE ASVAD?

- Pressure chamber.
- Safety Floater.
- Upper container.
- Locking cylinder.
- Closing piston.
- Fixing cylinder.
- Shut-off plug.
- Opening spring.
- Spring container.
- Fixing screws.
- Opening piston.
- Upper cover.



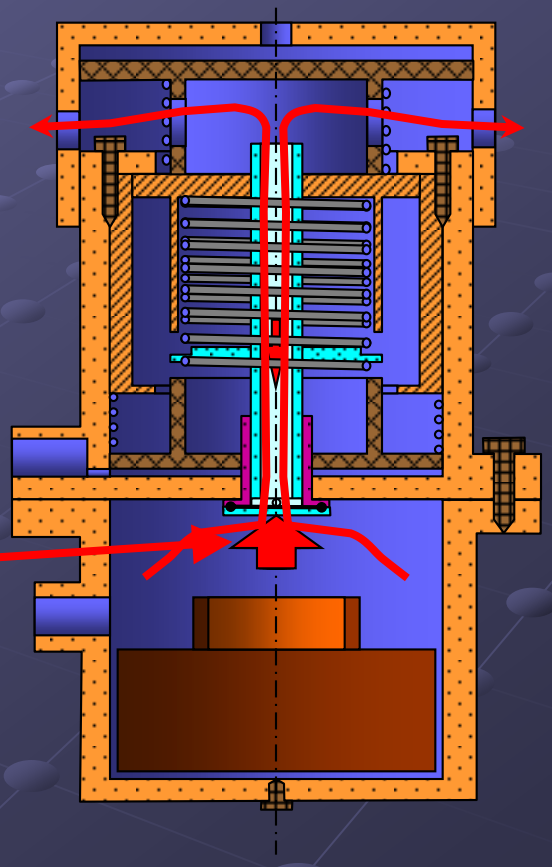
ACCIDENT OPERATION MODE

The ASVAD operating principle is a balance of forces. At normal pressure, there is a force upwards that overcomes the spring force. This force keeps the shut-off plug closed. This is the normal operating position.

With the accumulator water injection, the nitrogen gas expands, and the pressure in the accumulator drops until a certain value is reached. Now, the force of the opening spring is enough to move the shut-off plug off its seat, opening the path from the pressure chamber to the outlet exhaust ports.

Once this happens, the pressure drops quickly in the bottom pressure chamber, and the shut-off plug reaches its full opened state.

This provides an open path to exhaust all the residual nitrogen in the accumulator.



MANUAL OPERATION MODE

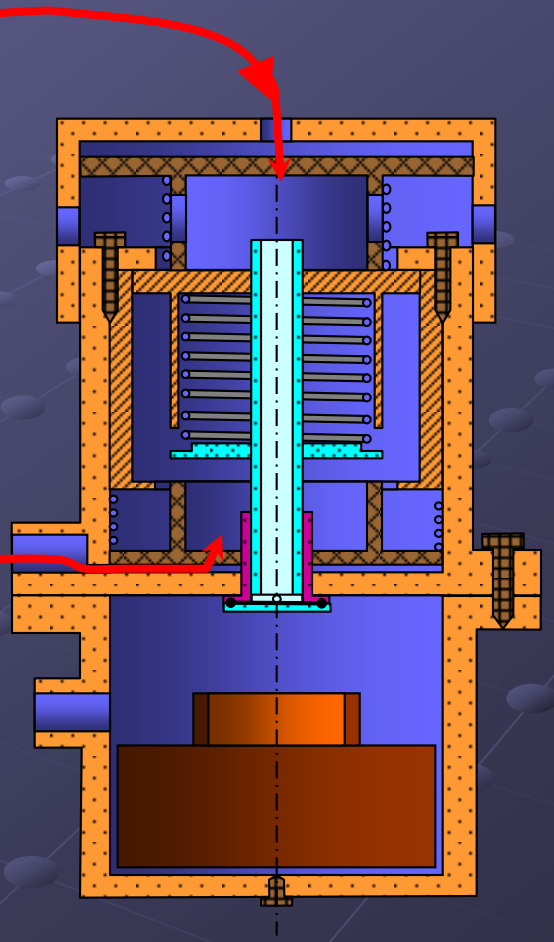
To unconditionally open the ASVAD, apply pressurized air to the “open” inlet.

The air pressure pushes the opening piston downwards, pushing the shut-off subassembly stem until the plug opens. This maneuver can be done to depressurize the accumulators if necessary.

To unconditionally close the ASVAD, apply pressurized air to the “close” inlet.

The air pressure pushes the closing piston upwards, pushing up the shut-off subassembly until the plug closes. This maneuver can be done after a previous depressurization to allow refilling the accumulator.

When the air is exhausted, both pistons return to their initial position, and ASVAD remains armed.

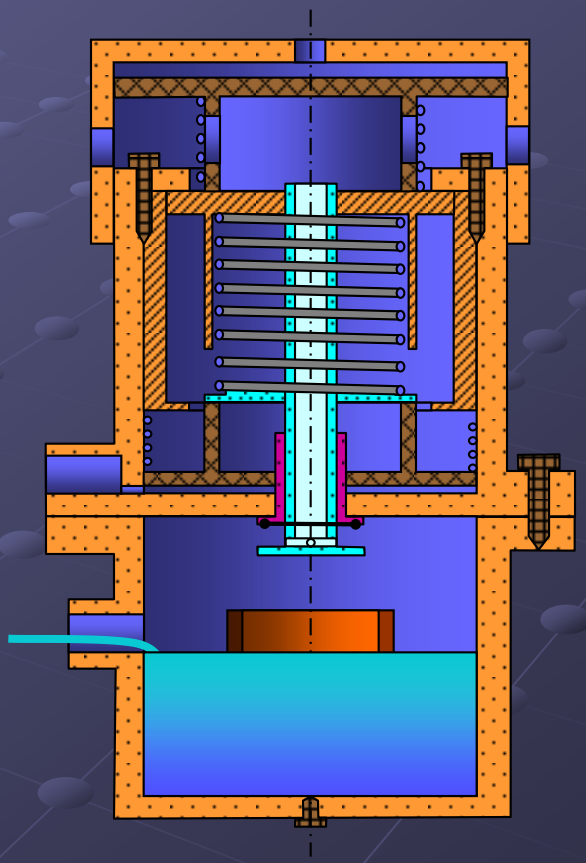


OPTIONAL REDUNDANCY

Finally, there is a ASVAD design feature to avoid leaks from RCS even in case the accumulator non-return valve leaks.

After actuating, the ASVAD remains open. If there is an in-leakage, the accumulator water level will rise until reaching the ASVAD pressure chamber.

Once the water fills the chamber, the security floater starts to float and rises until completely covering the open shut-off plug and seat to stop the leak.



4 ADVANTAGES OF ASVAD.

- **NO EXTERNAL ENERGY** is needed.
- **NO OPERATOR** assistance is required.
- Performs its function at the **CORRECT MOMENT**.
- Operators can **FORGET ABOUT** Nitrogen Injection Issue, and focus on performing other mitigation tasks.

- HIGH RELIABILITY due its robust and simple design.
- EASY TO BE INSTALLED in the accumulator system.
- EASY TO BE LICENSED because its installation do not impact negatively in the accumulator injection system design (it tends to remain closed all the time).
- EASY TO BE OPERATED. It can be remotely actuated when needed.
- EASY TO BE MAINTAINED & TESTED. No wear in the valve.
- Its qualified life can be high… (No further investment$ required).

5 CONCLUSION.

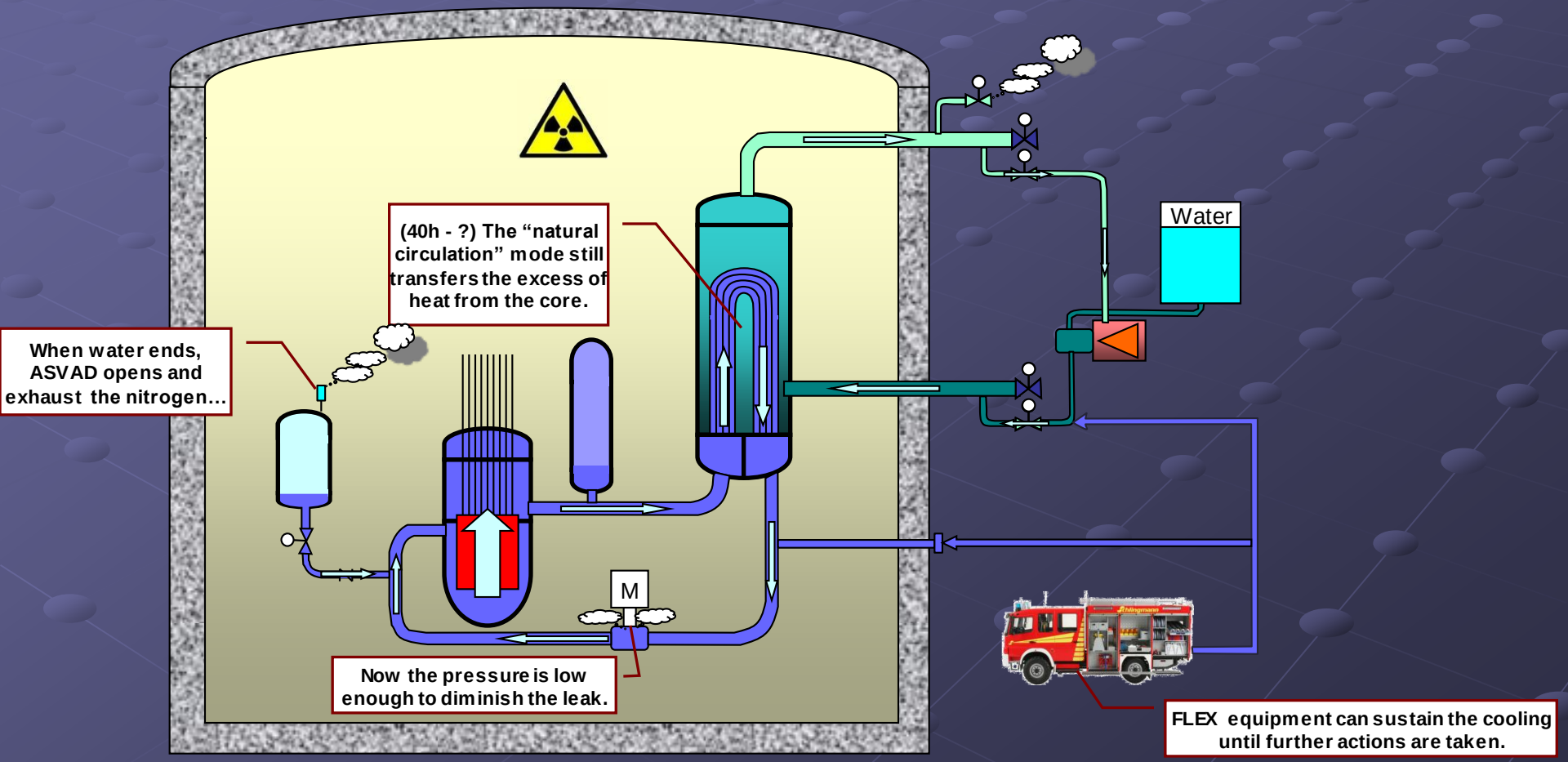
Now, we know enough about:

- The ELAP induced Nitrogen Injection Issue and its risks.
- The ASVAD assembly, and how it operates.
- The ASVAD advantages & benefits.

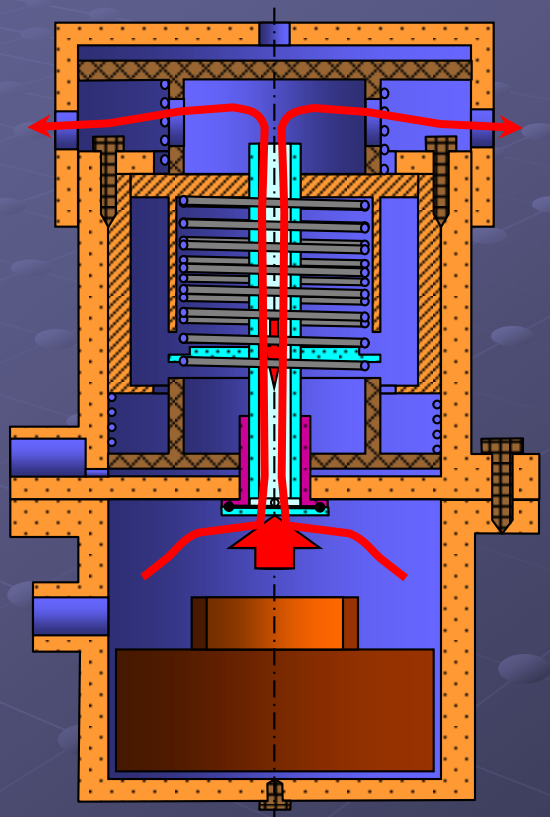
ASVAD It's a **GOOD SOLUTION** to avoid the risk of RCS Nitrogen Injection, and to **ENHANCE THE STRENGTH** of the plant to cope with the ELAP accident.

THIRD STAGE: WITH ASVAD, THE ACCIDENT NOT WORSENS

THE PROBLEM: ONLY THE LOSS OF COOLANT



6 QUESTIONS?



Now is **YOUR** time to ask...

THANK YOU FOR YOUR ATTENTION!