Union of Concerned Scientists

Dry Storage Issue at San Onofre

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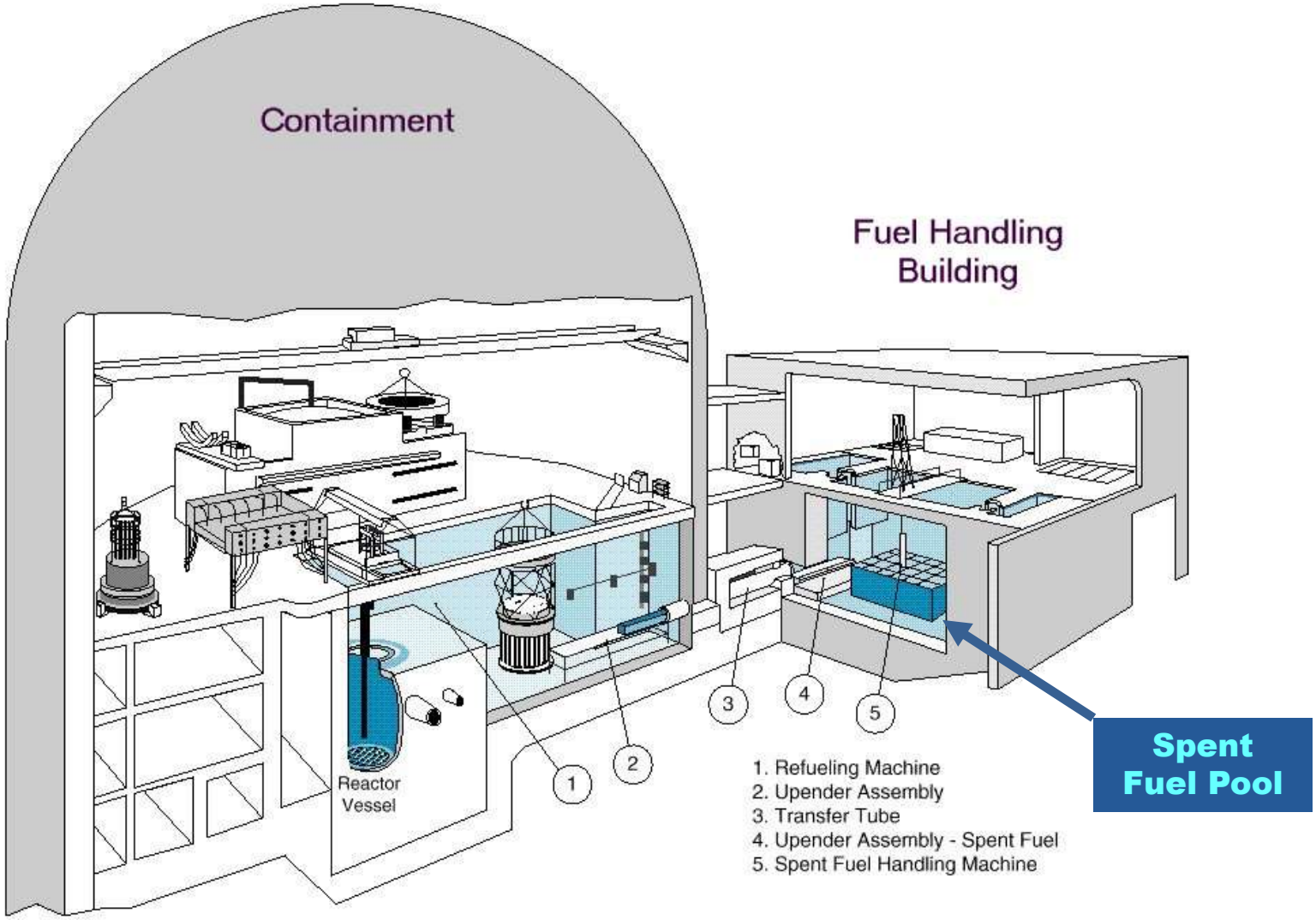
Top Line

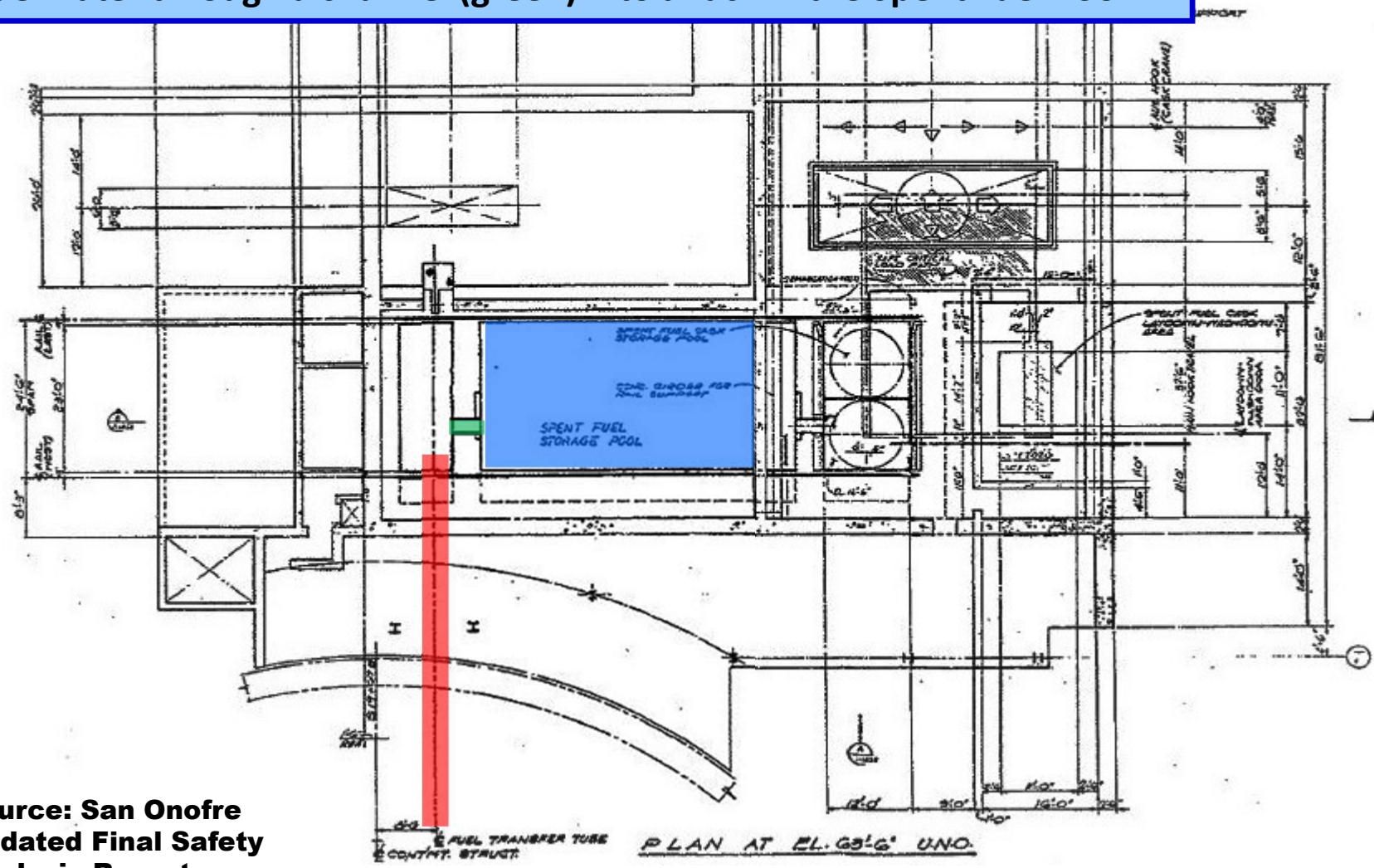
During the August 9, 2018, Community Engagement Panel meeting, a worker revealed that a spent fuel canister could have been dropped on August 3rd due to poor performance by two workers.

Background



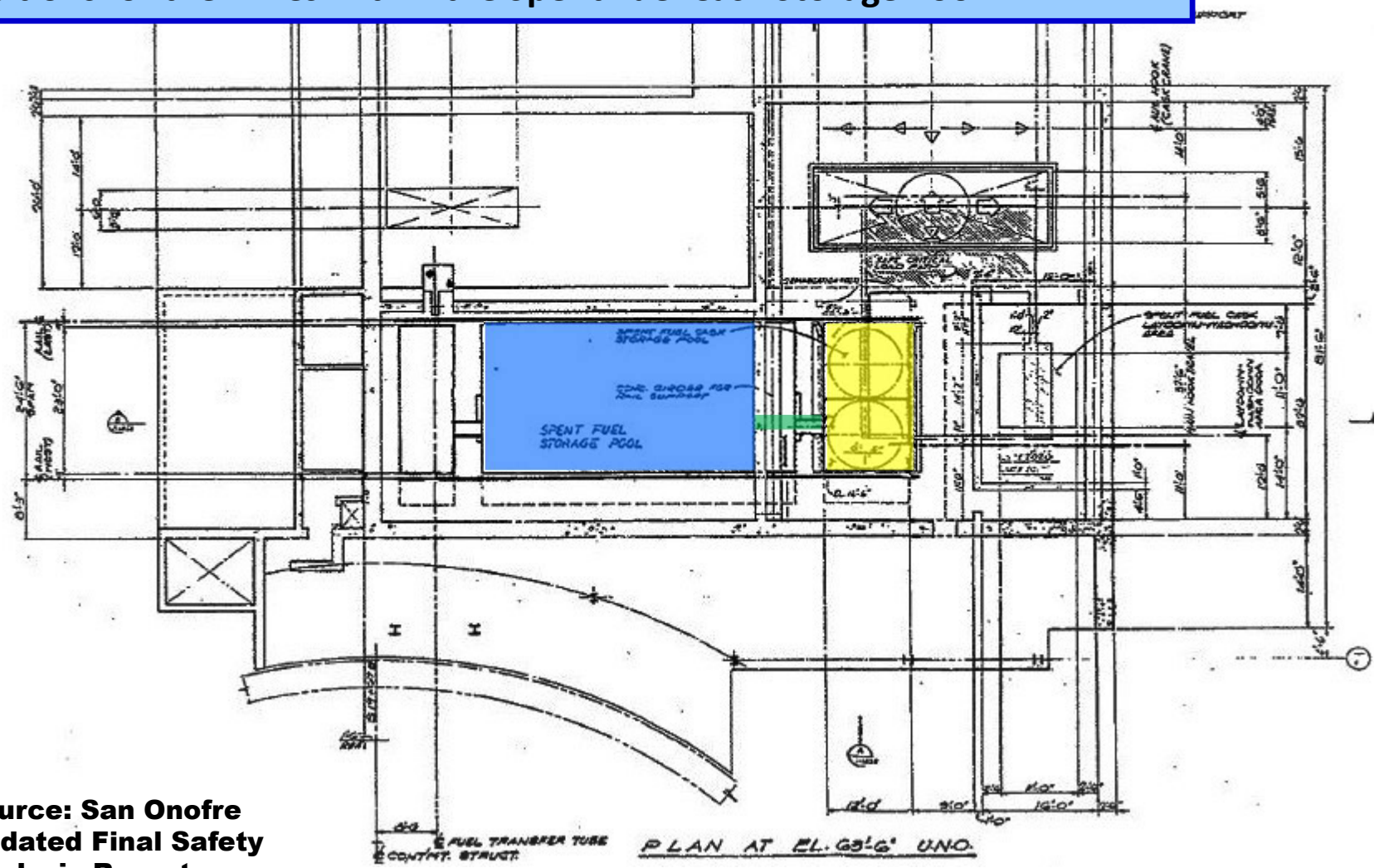
Irradiated fuel was transferred from the reactor vessel (left) inside Containment through the horizontal transfer tube (3) to the Fuel Handling Building where it was placed in storage racks within the Spent Fuel Pool.

Looking down at the Fuel Handling Building: Irradiated fuel moved through the horizontal transfer tube (red) into the Upender region of the Spent Fuel Pool (blue). The Upender rotated the irradiated fuel to the vertical position so the fuel handling platform could transport it underwater through a channel (green) into a rack in the Spent Fuel Pool.



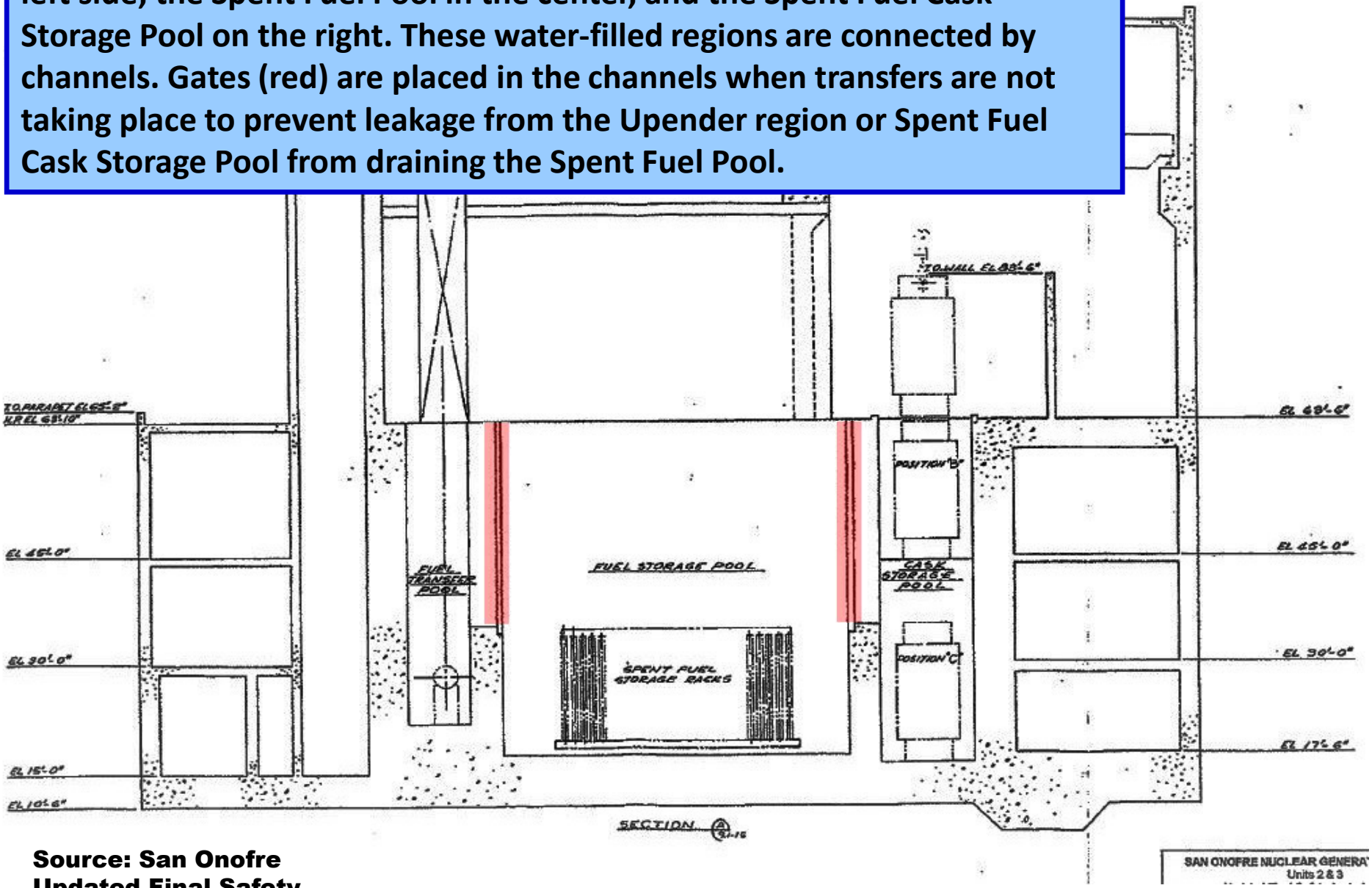
Source: San Onofre Updated Final Safety Analysis Report

Looking down at the Fuel Handling Building: Irradiated fuel is moved through another channel (green) into the Spent Fuel Cask Storage Pool (yellow) where it is placed within a Multi-Purpose Canister (MPC). The two circles within the Spent Fuel Cask Storage Pool represent two different positions for the MPCs within the Spent Fuel Cask Storage Pool.



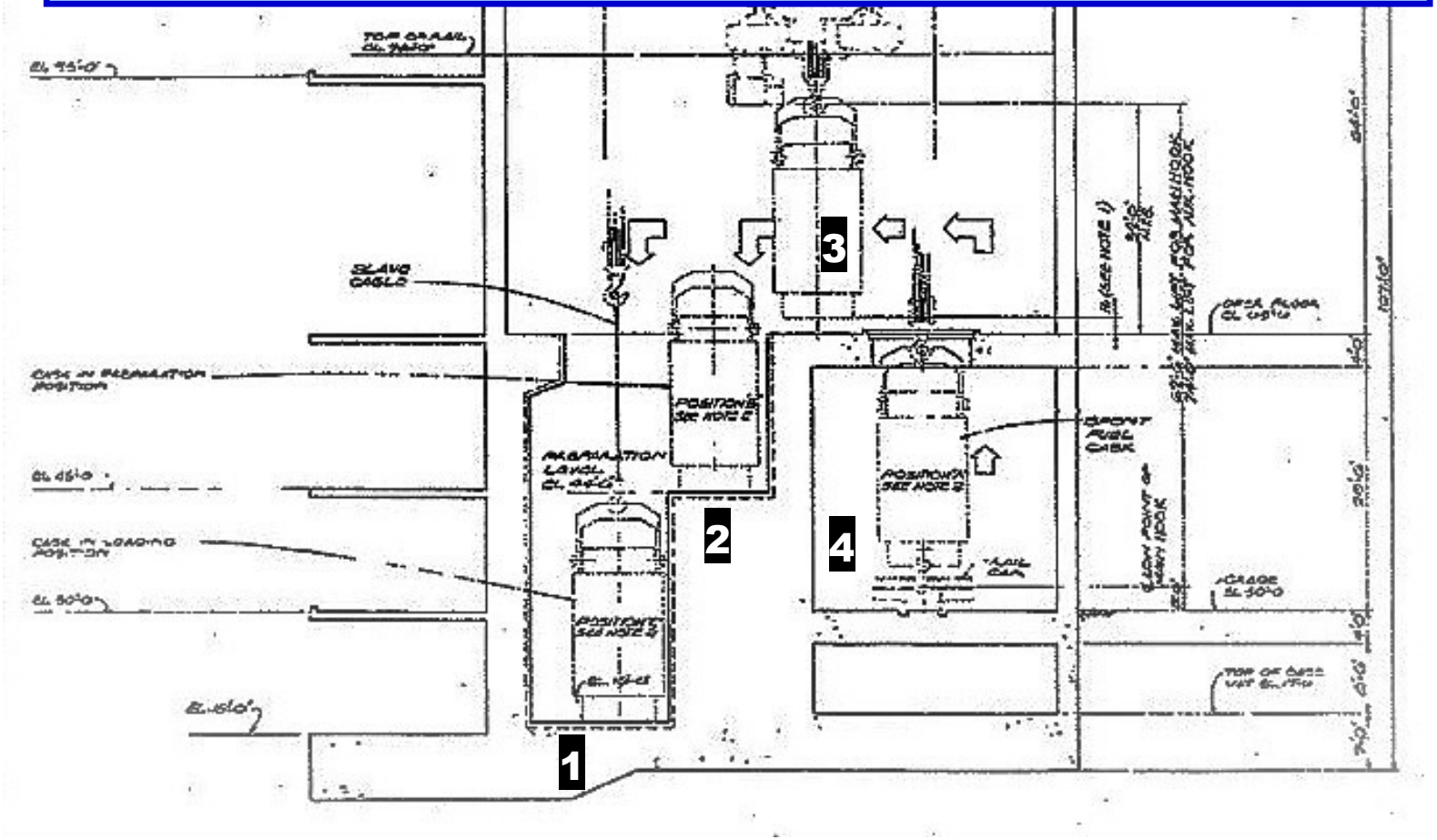
Source: San Onofre Updated Final Safety Analysis Report

Looking at the Fuel Handling Building profile: The Upender region is on the left side, the Spent Fuel Pool in the center, and the Spent Fuel Cask Storage Pool on the right. These water-filled regions are connected by channels. Gates (red) are placed in the channels when transfers are not taking place to prevent leakage from the Upender region or Spent Fuel Cask Storage Pool from draining the Spent Fuel Pool.



Source: San Onofre Updated Final Safety Analysis Report

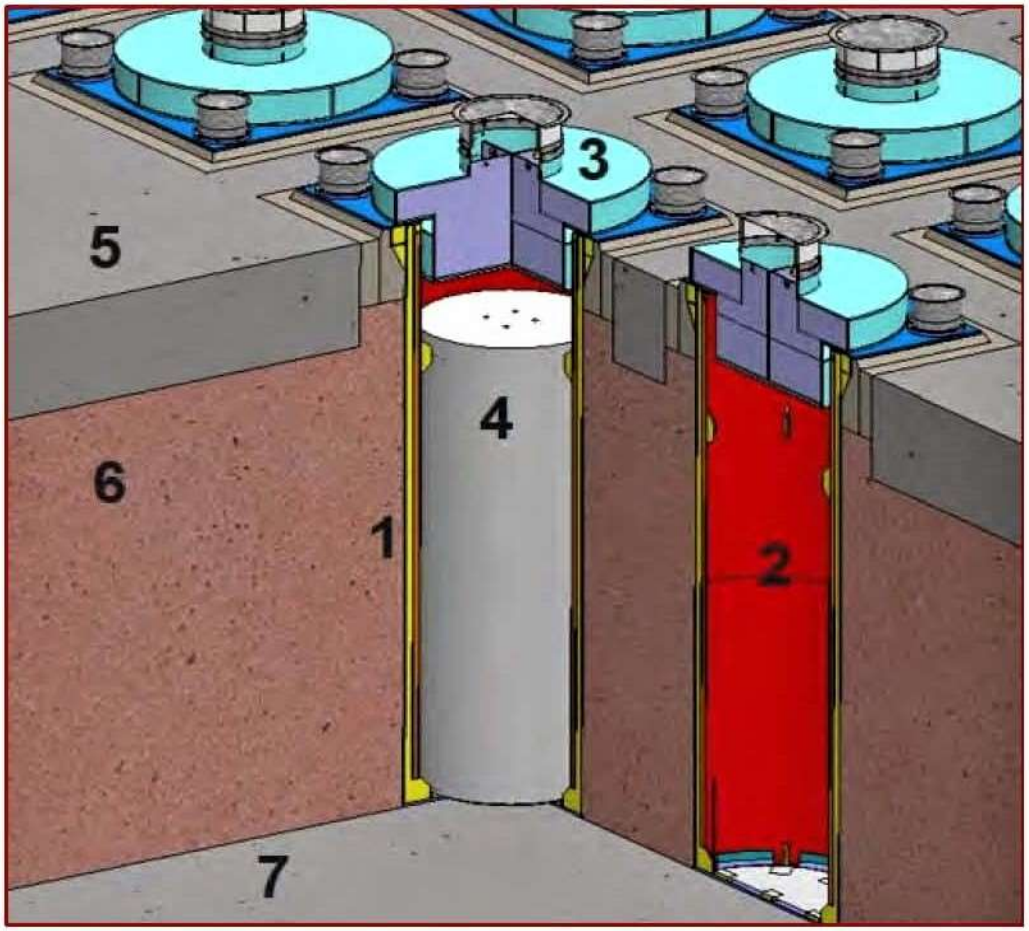
Looking at the Fuel Handling Building profile: The Spent Fuel Cask Storage Pool has two elevations. An MPC is placed in the lower elevation (1) to be loaded with irradiated fuel. An MPC is lifted to the "step" (2)to secure its lid. The MPC is then lifted to the refueling floor (3). The MPC is lowered to the ground-level truck bay (4) for transport to the onsite storage pad.



Source: San Onofre Updated Final Safety Analysis Report

The storage pad, or Independent Spent Fuel Storage Installation, is located north of the plant. The spent fuel for Unit 1 is housed in horizontal vaults (1). The MPC containing spent fuel for Units 2 and 3 are being placed in underground vaults (2) (each white circle marks an MPC storage location.)

Source: SCE Slides
November 2, 2017

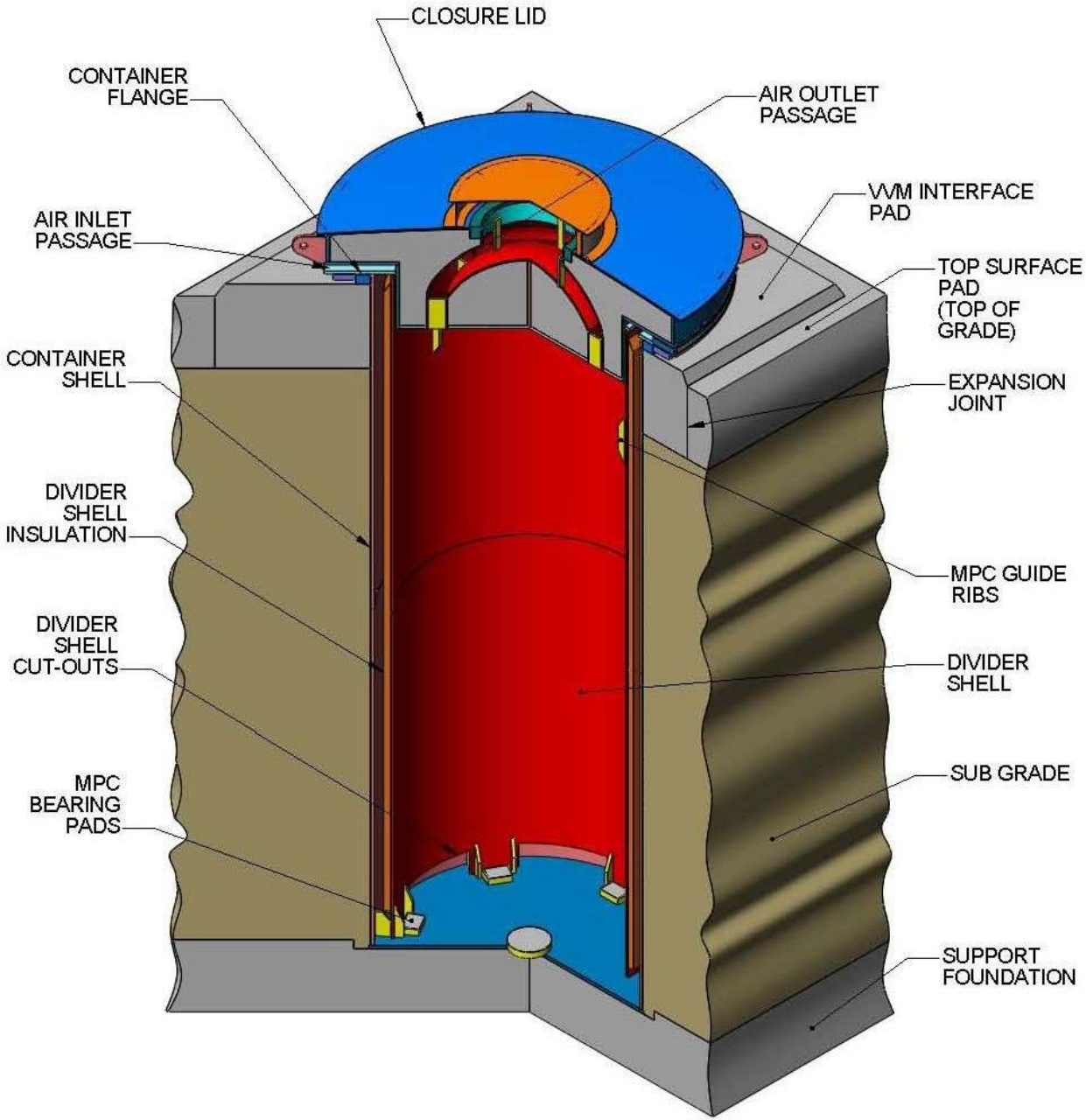


#	Component
1	Cavity Enclosure Container (CEC)
2	Divider Shell
3	Closure Lid
4	MPC-37 Multi-Purpose Canister
5	ISFSI Pad
6	Self-Hardening Engineered Subgrade (SES)
7	Support Foundation Pad (SFP)

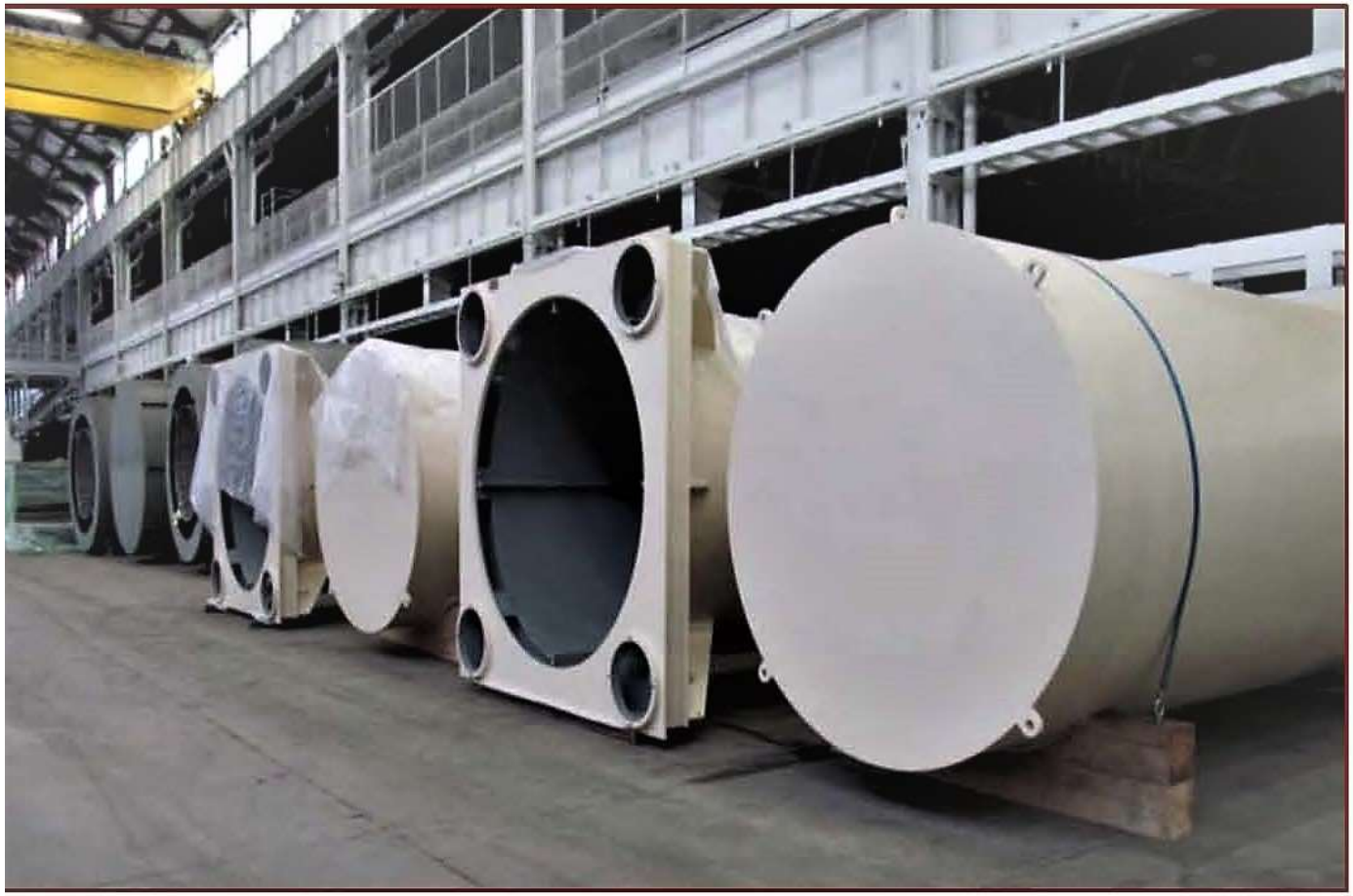
Cross-section view of the underground storage area: MPCs (4) are lowered into metal Cavity Enclosure Containers (1) solidly placed in the concrete block (6). The Closure Lid (3) is placed on the Cavity Enclosure Container.

Source: Holtec International

Cross-section view of a single underground storage unit before an MPC is placed in it.



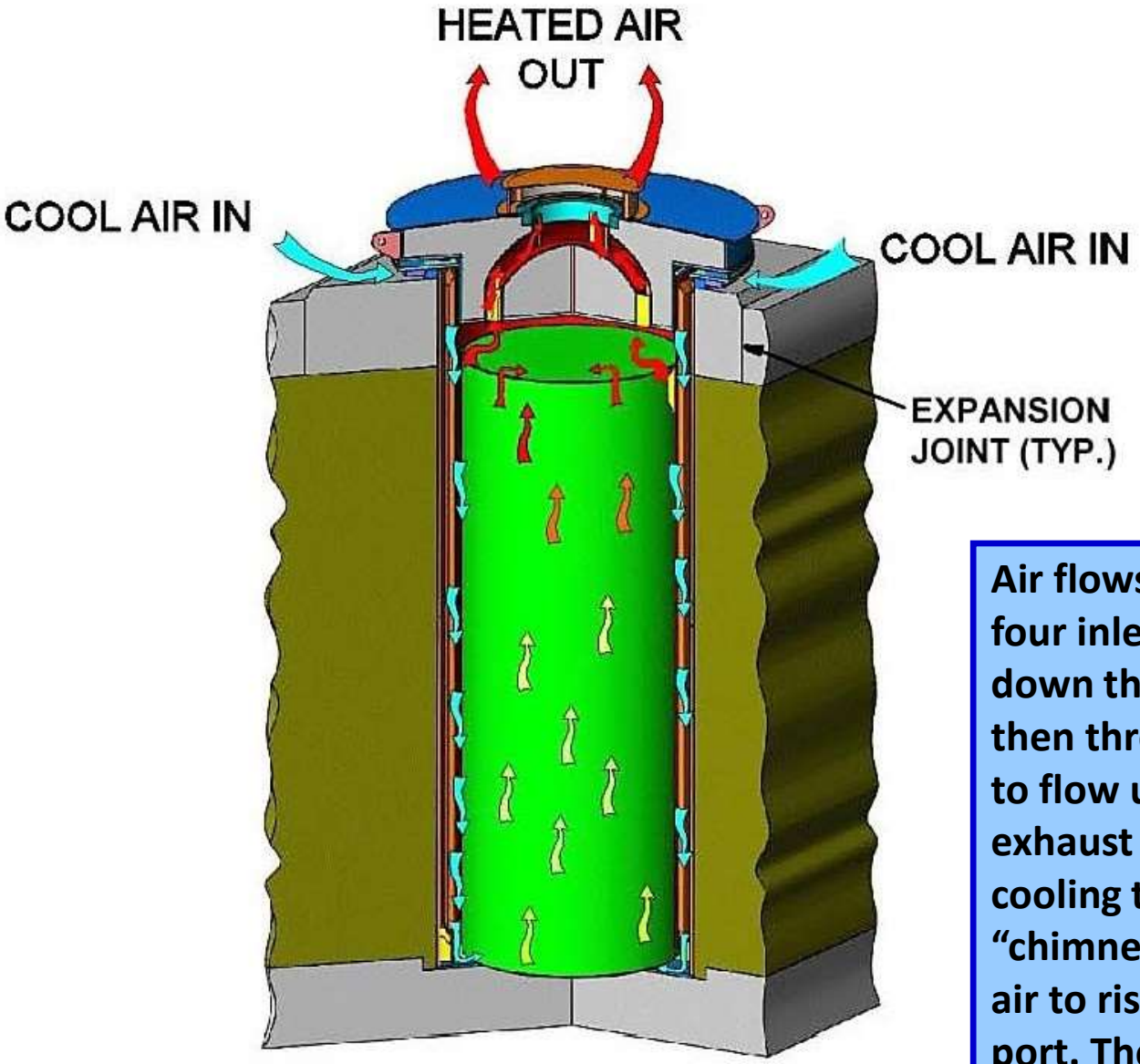
Source: [Holtec International]



Fabricated CECs at the HOLTEC Manufacturing Division

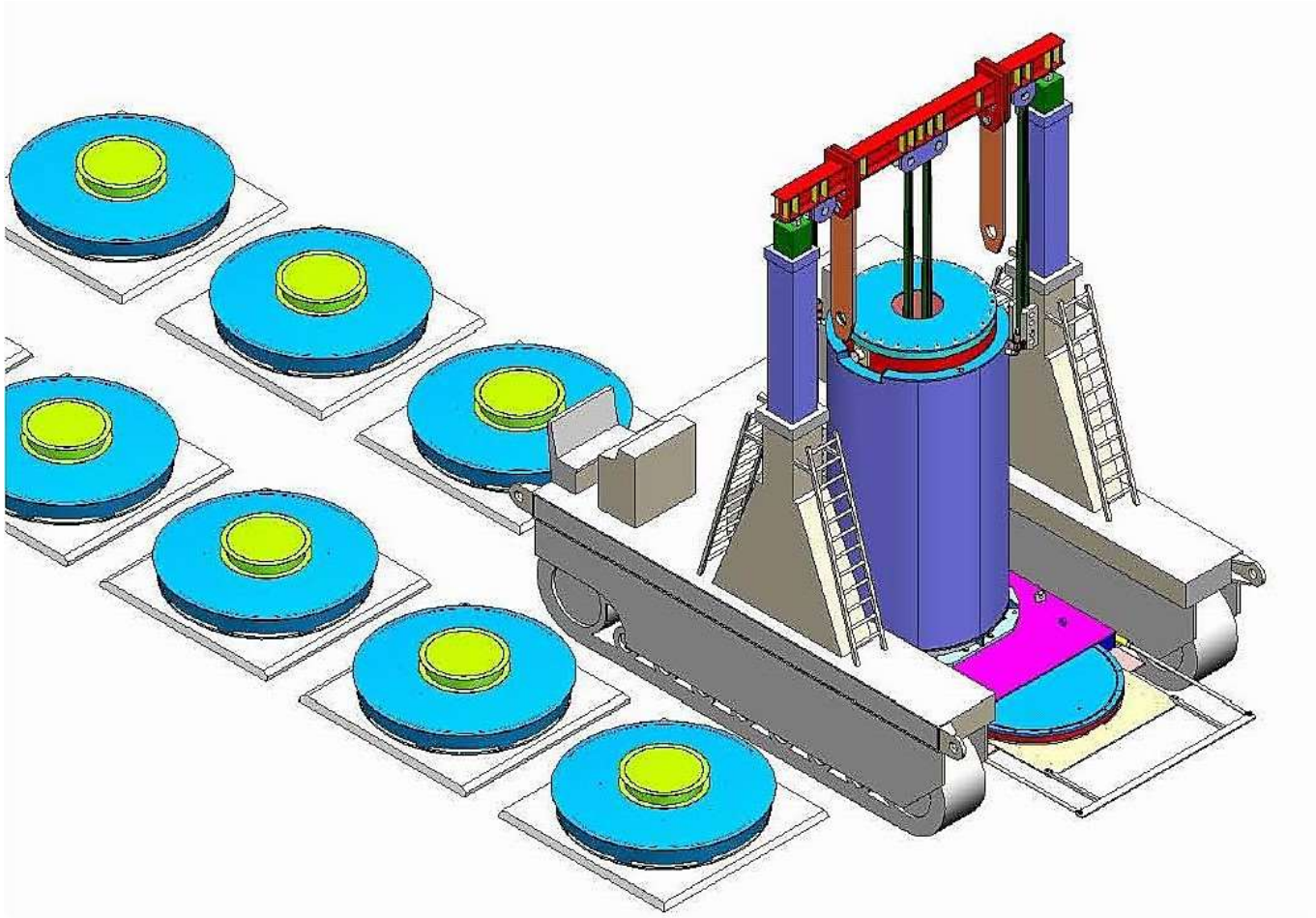
Row of Cavity Enclosure Containers (CECs). The CEC on the right has its bottom end facing the camera. The next CEC has its top end showing. The four openings on the corners allow cooling air to flow into the unit.

Source: Holtec International



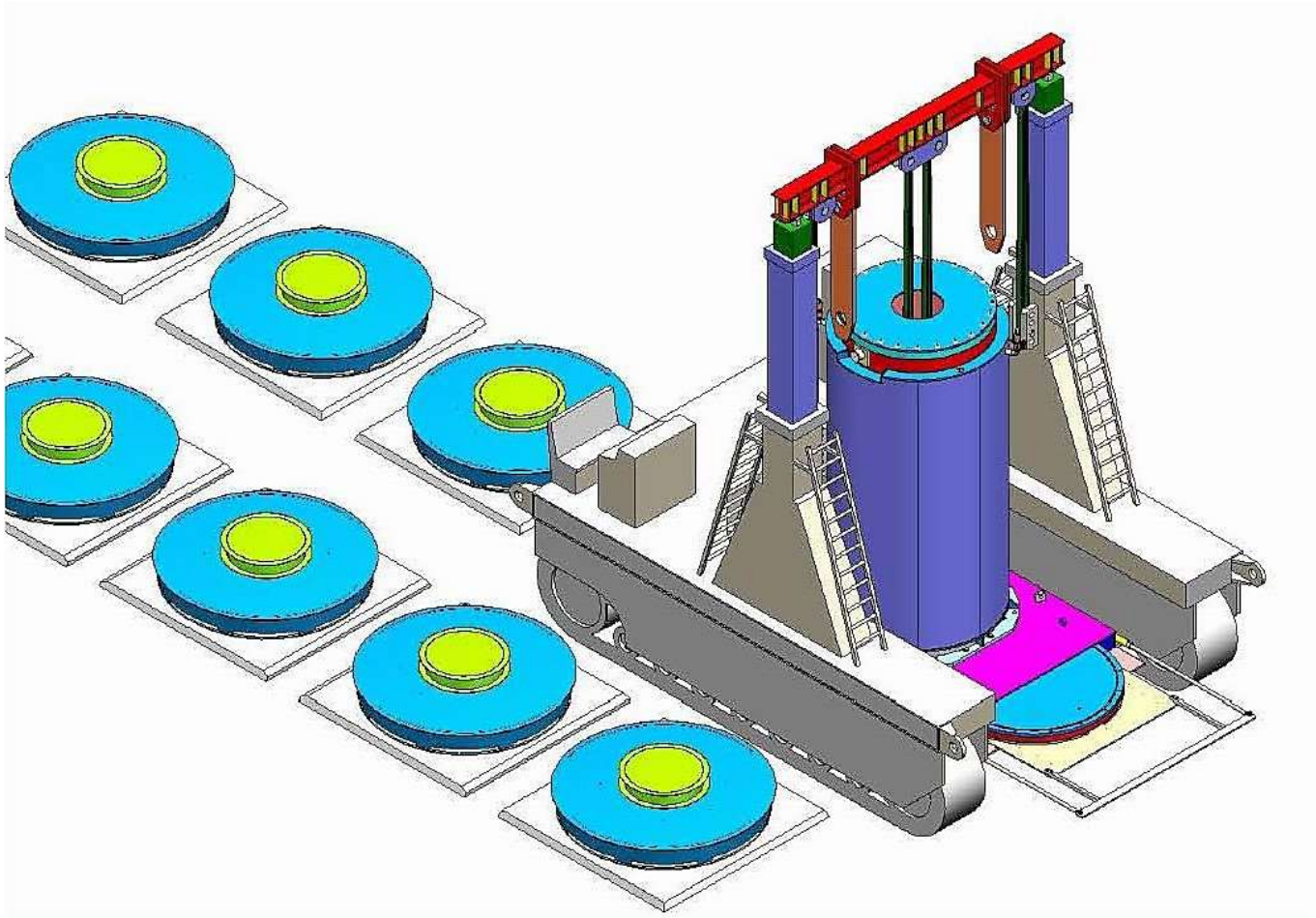
Source: [Holtec International]

Air flows into the unit through the four inlets in the container flange, down the annulus region and then through ports at the bottom to flow upward and out the exhaust port. This is passive cooling through convection. The "chimney effect" causes warmed air to rise and leave the exhaust port. The leaving warm air pulls cool air in through the four inlets.



A loaded MPC weighs about 45 tons. A special transport rig is used to move the loaded MPC from the Fuel Handling Building to the Independent Spent Fuel Storage Installation. This rig is used to lower the MPC into the Cavity Enclosure Container.

Source: Holtec International

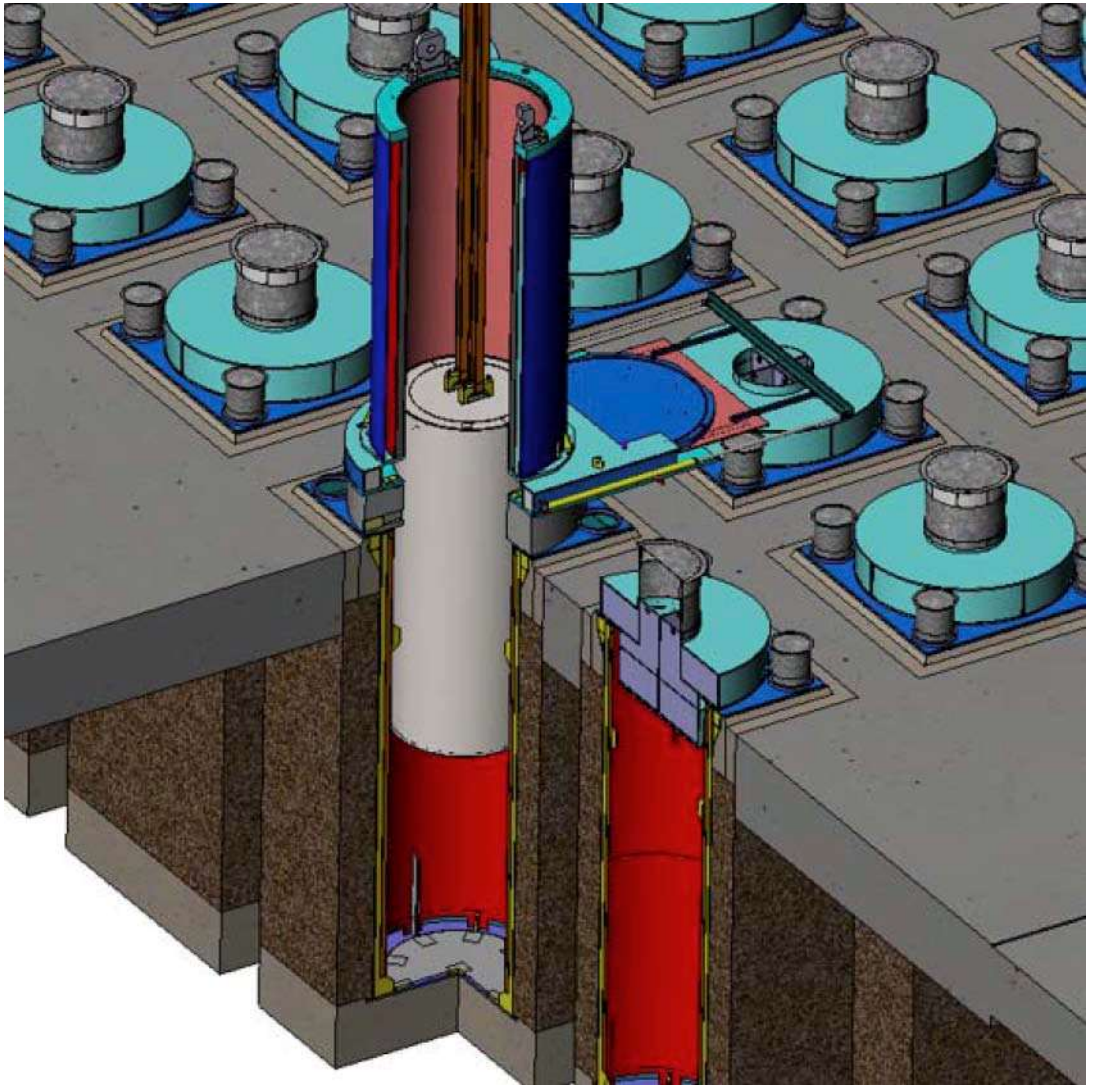


The MPC contains highly radioactive spent fuel. The Cavity Enclosure Containers and concrete vaults shield workers and the environment. During transport, the MPC is within a transport sleeve that shields workers from radioactive emissions. The red top of an MPC and its blue closure lid are peeking out from the top of a purple transport sleeve.

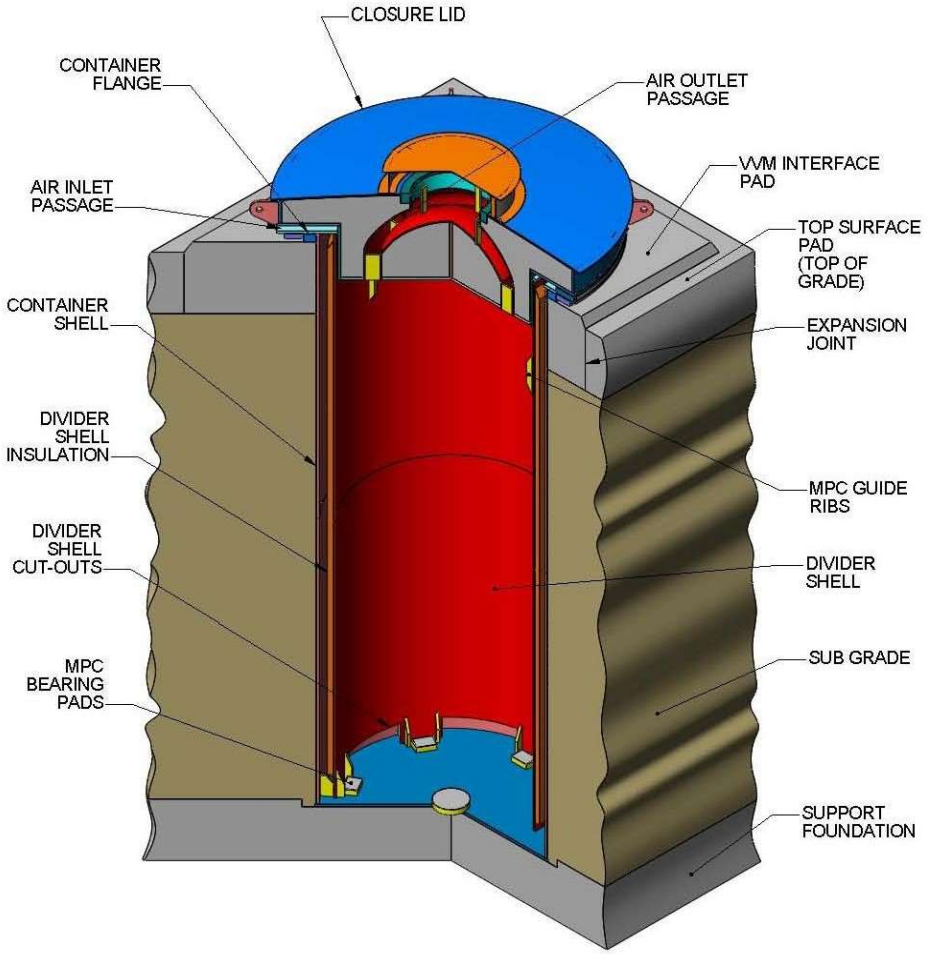
The special transport rig is "invisible" in this graphic to show an MPC being lowered into a Cavity Enclosure Container (CEC).

At this point, the MPC is more than halfway out of the transport sleeve into the CEC.

It takes about a minute for an MPC to be fully lowered into a CEC.



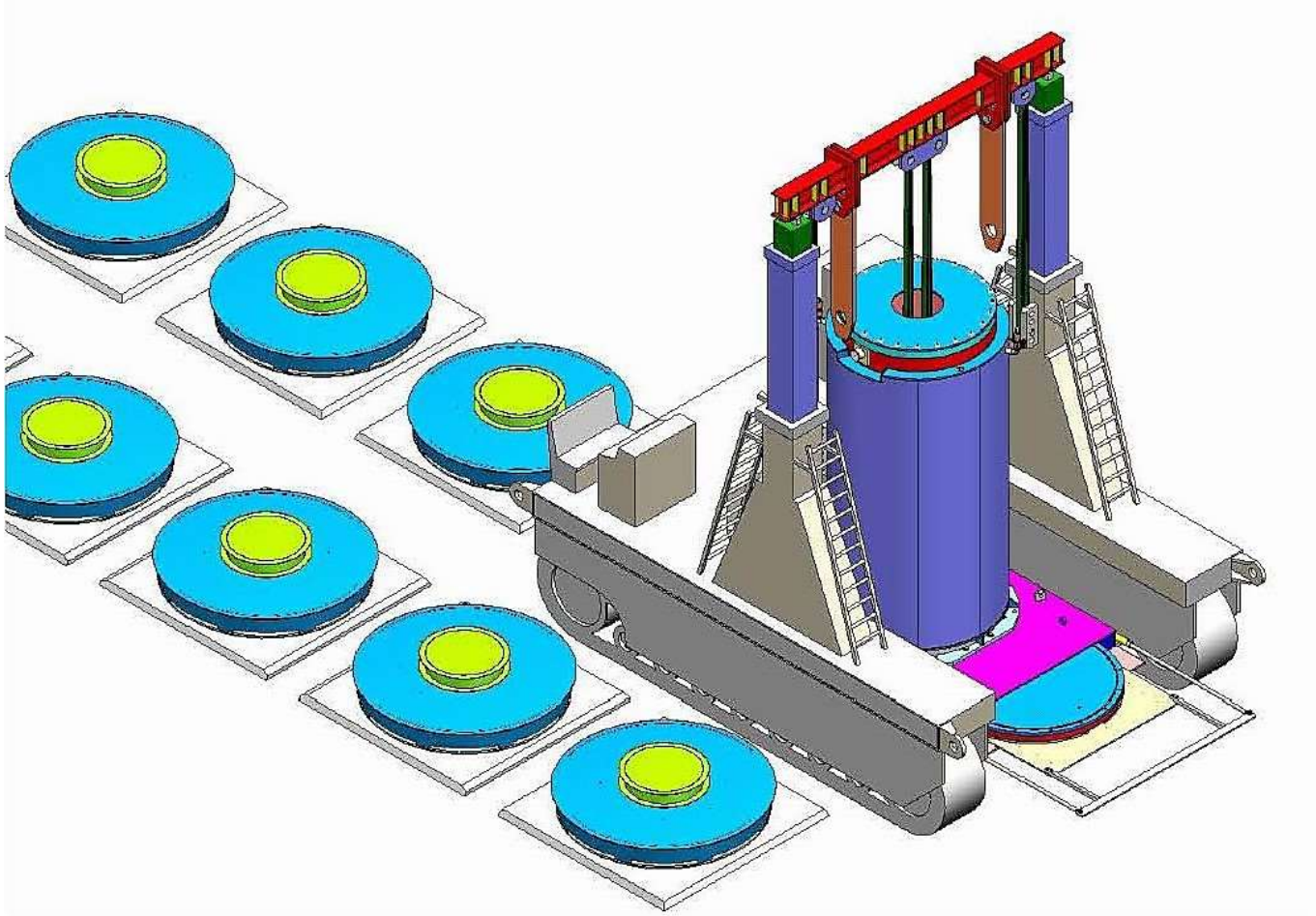
Source: SCE Slides
November 2, 2017



The MPC fits into the CEC like a hand in glove, except in this case the glove is rigidly made from steel. Guide ribs help align the MPC over the CEC and guide its lowering into place.

Source: [Holtec International]

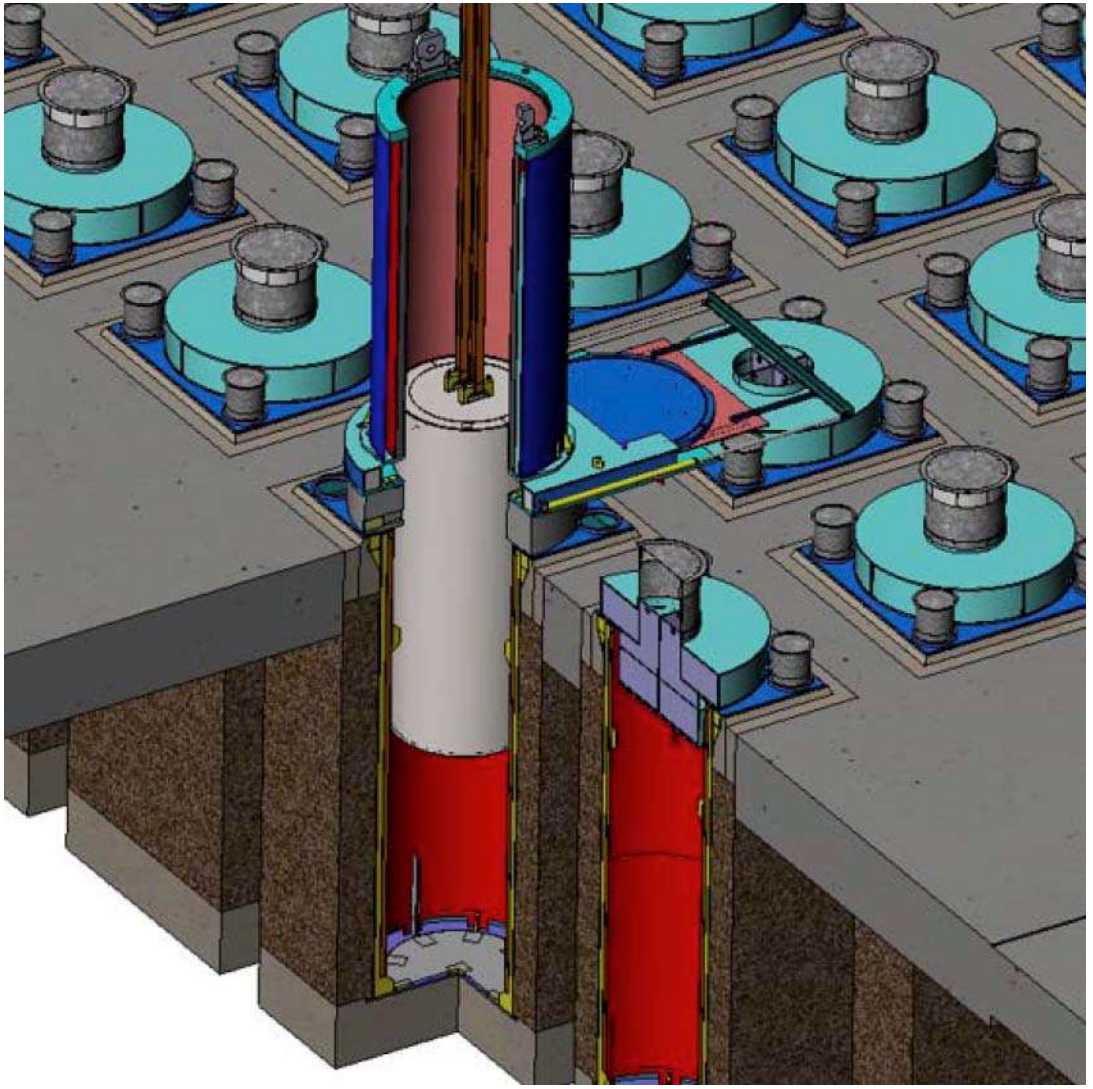
Foreground



On August 3, 2018, an MPC was not properly aligned for placement into the CEC. As workers manipulated controls on the special transport rig to lower the MPC, the rigging lowered. But the MPC got stuck and stopped moving. During the Community Engagement Panel meeting on August 9, 2018, a worker stated that the rigging was lowered another 18 feet before the MPC's non-movement was noticed.

Source: Holtec International

How Did the MPC Get Stuck?



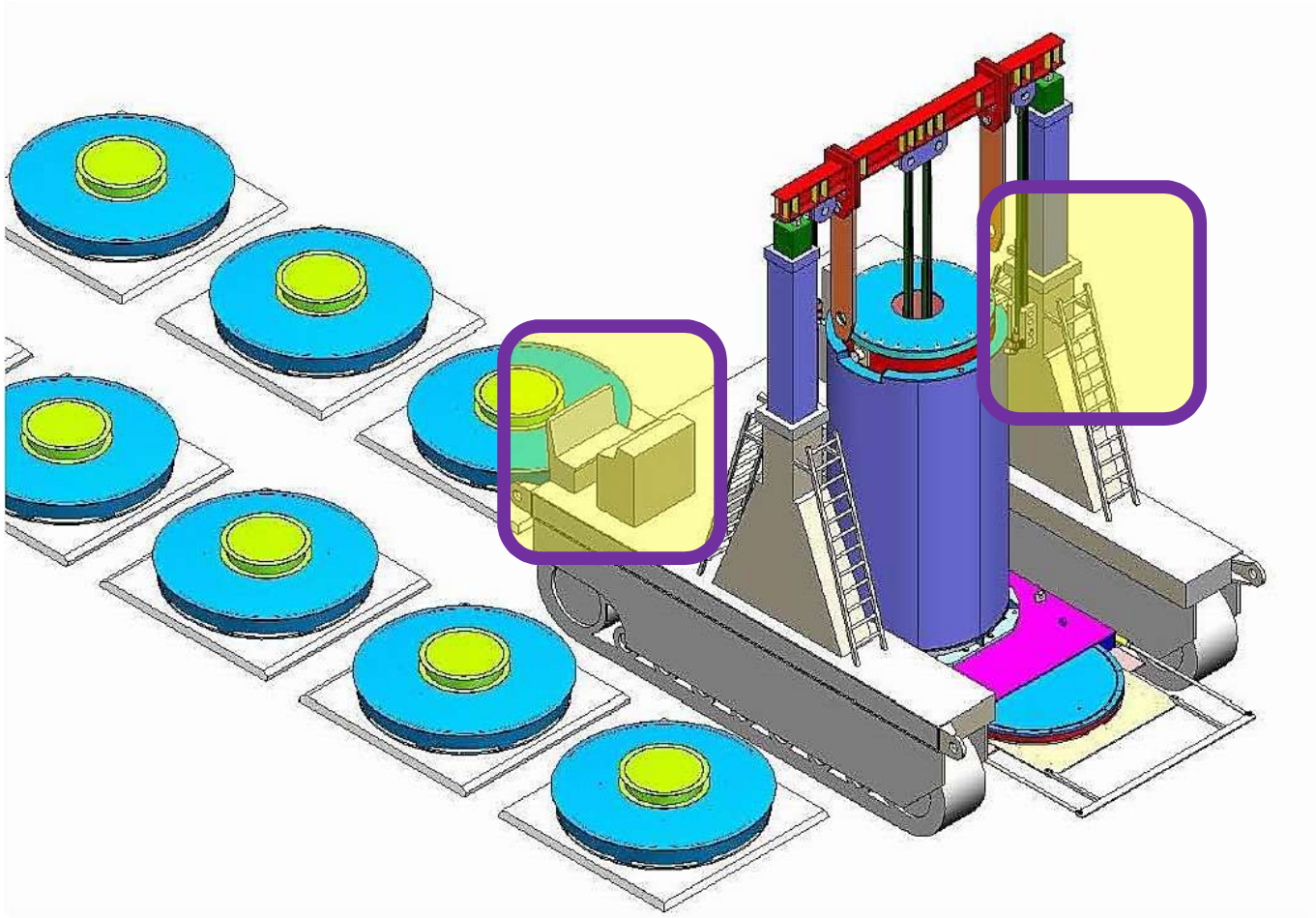
The bottom end of the MPC got caught on an edge with the CEC instead of sliding smoothing into it. Consequently, the rigging kept lowering but the stuck MPC did not.

Source: SCE Slides
November 2, 2017

How Did the MPC Get Stuck?

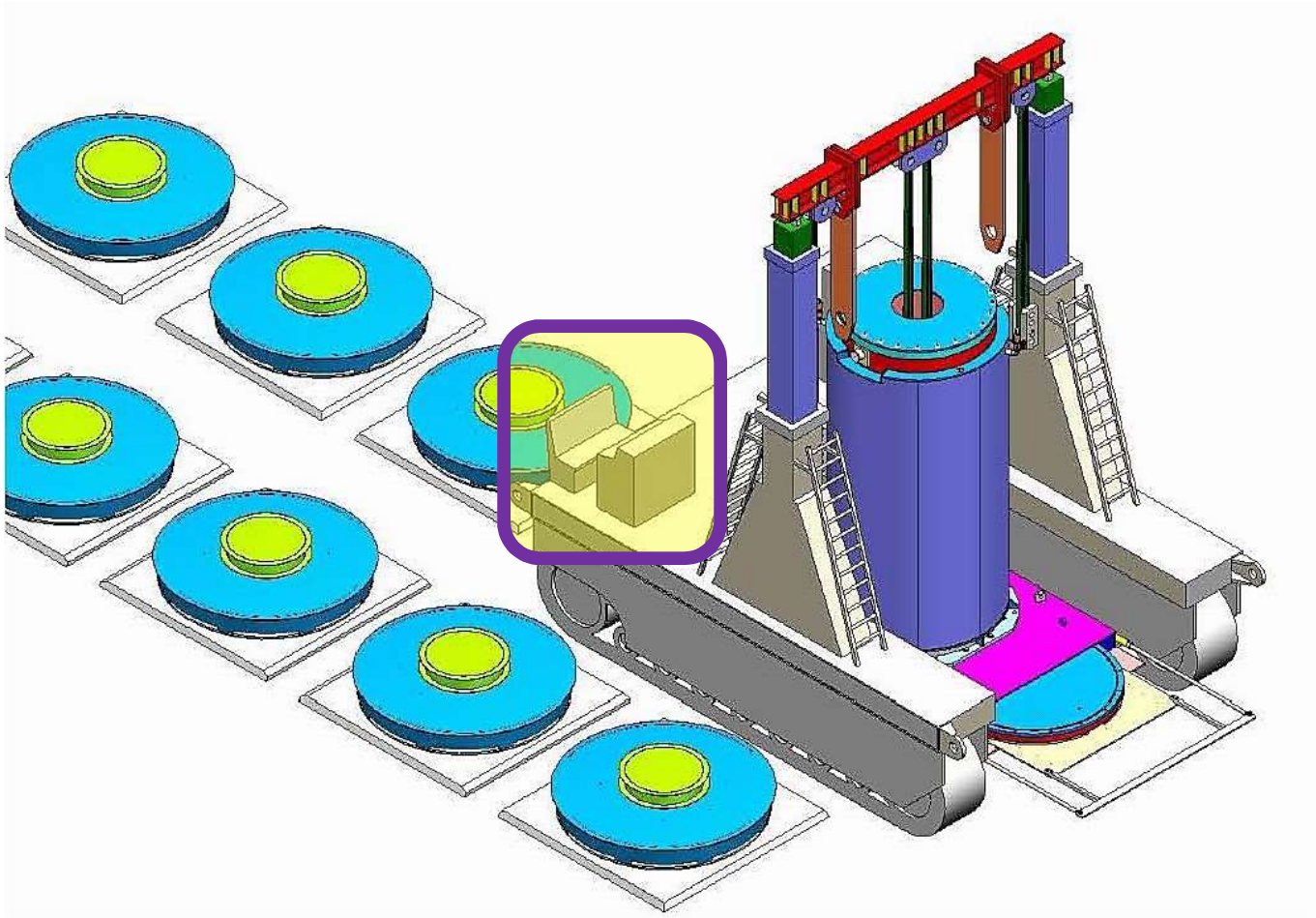
Not exactly a case of square peg in a round hole, but a case of a round peg not properly inserting into a round hole of only slightly larger diameter.

Why Didn’t the Stuck MPC Get Noticed?



Two workers were assigned to monitor the MPC being lowered into the CEC. The worker at the controls (left) could toggle between indications of the MPC movement and the rigging alignment. Another worker was tasked with visually monitoring the top of the MPC as it was lowered into the CEC.

Source: Holtec International



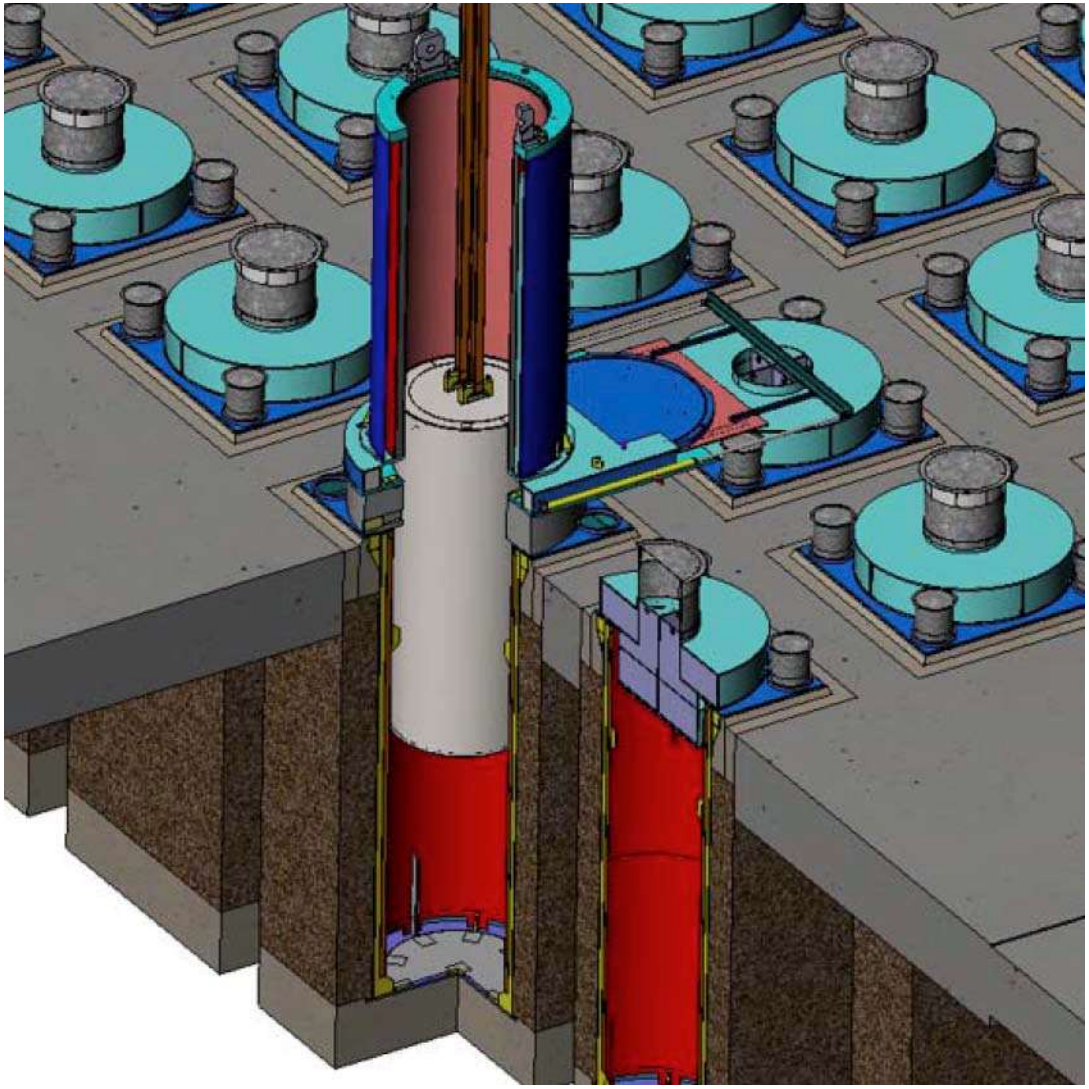
Once the MPC began moving, the "eyeball" worker retreated to a safer distance to reduce radiation dose. The worker at the controls fixated on ensuring both sides of the rigging remained level. After about 30 seconds, the worker saw that the MPC was not moving, but mistakenly thought the indication meant it had reached the bottom of the CEC. It had not.

Source: Holtec International

Why Didn't the Stuck MPC Get Noticed?

Workers juggling competing concerns (i.e., dose reduction and rigging performance) let the ball drop by failing to notice that the MPC was <u>not</u> dropping.

How Did the Stuck MPC Get Noticed?



A Radiation Protection technician surveyed the Cavity Enclosure Container and detected radiation levels higher than expected for a properly loaded MPC.

A worked looked into the transport sleeve and observed the top of the MPC at a higher level than desired.

About 20 minutes after being noticed in the wrong position, the MPC was unstuck and lowered fully into the CEC.

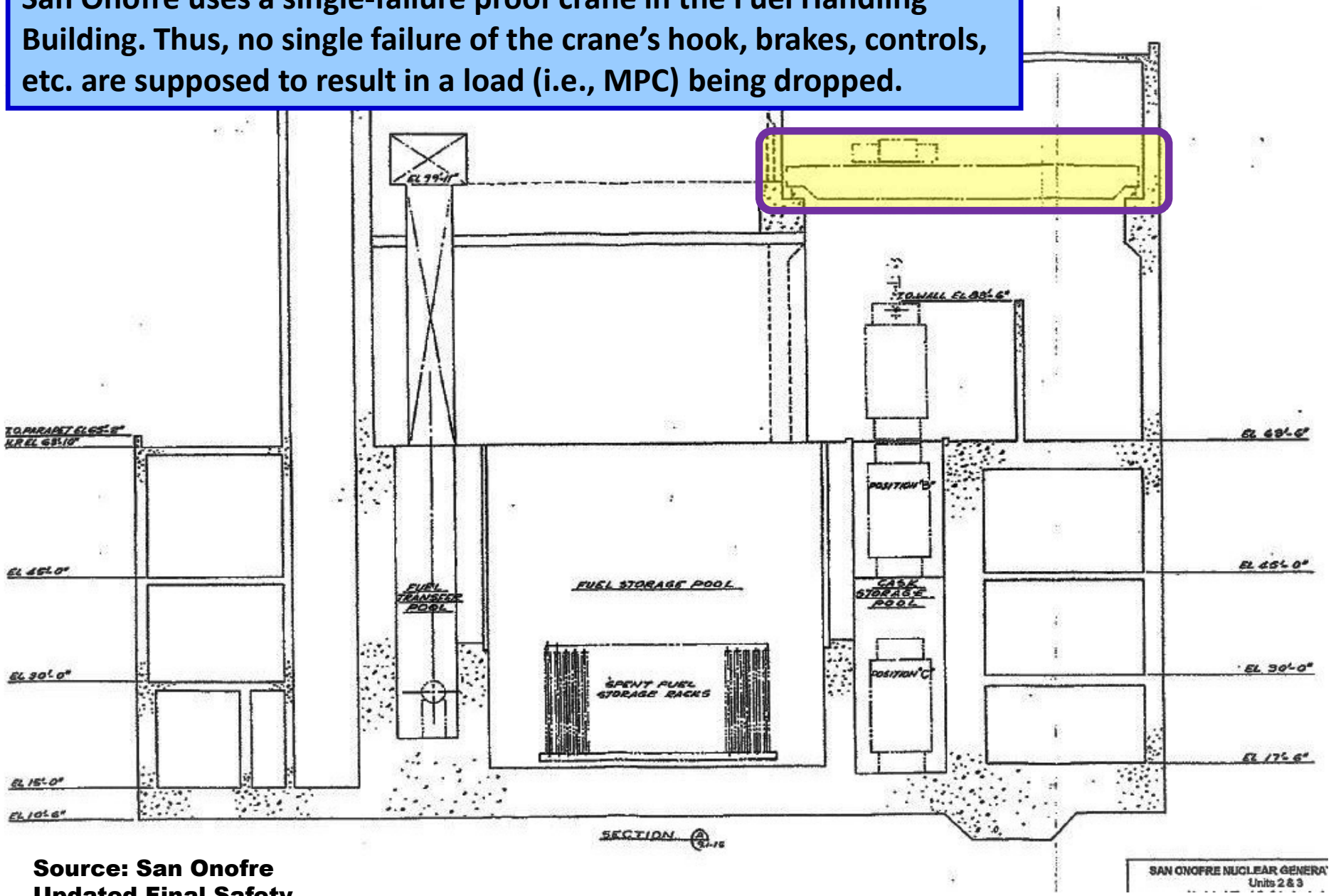
Source: SCE Slides
November 2, 2017

How Did the Stuck MPC Get Noticed?

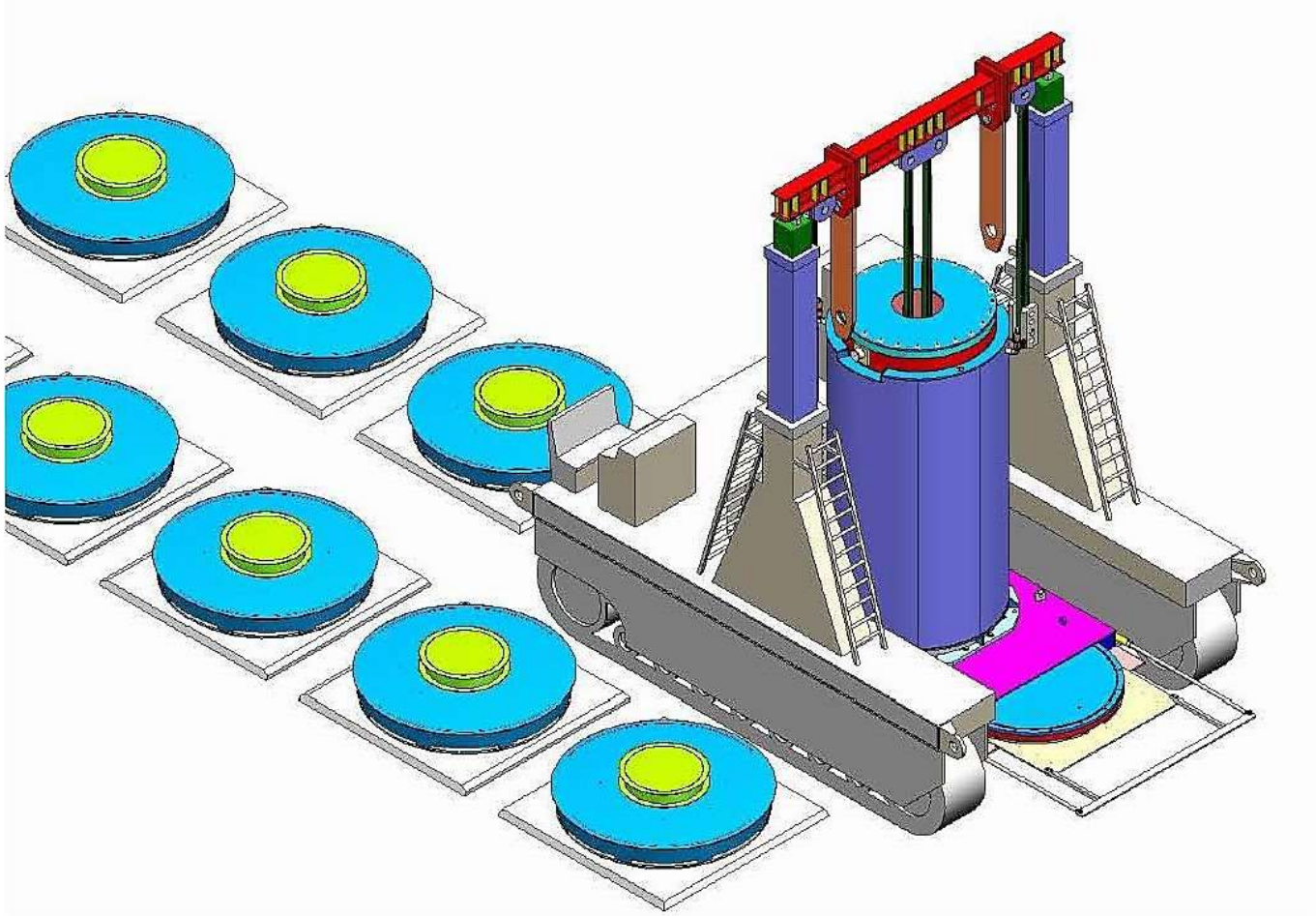
By procedure, Radiation Protection surveyed the area after the MPC was thought to have been placed in the CEC. Unexpectedly high radiation readings lead to the stuck MPC being noticed.

Could the MPC have been dropped?

San Onofre uses a single-failure proof crane in the Fuel Handling Building. Thus, no single failure of the crane's hook, brakes, controls, etc. are supposed to result in a load (i.e., MPC) being dropped.



Source: San Onofre Updated Final Safety Analysis Report



The special transport rig can only lift a MPC a few feet off the ground and is also single-failure proof. The farthest that a rig could conceivably drop the MPC would be less than 30 feet into a Cavity Enclosure Container.

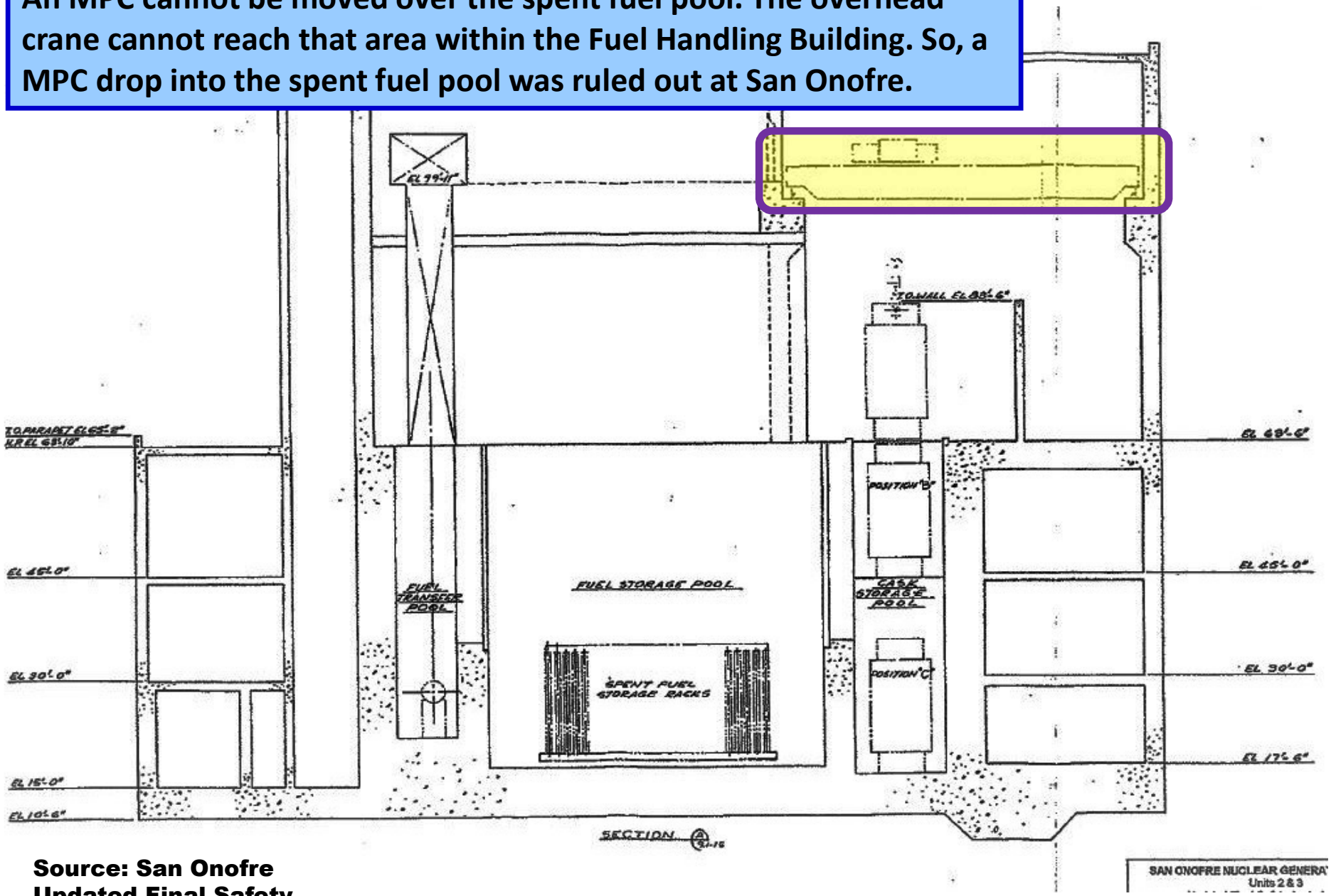
Source: Holtec International

Could the MPC have been dropped?

An MPC is not likely to be drop in the Fuel Handling Building due to its single-failure proof crane. An MPC cannot be dropped over 30 feet from the special transport rig.

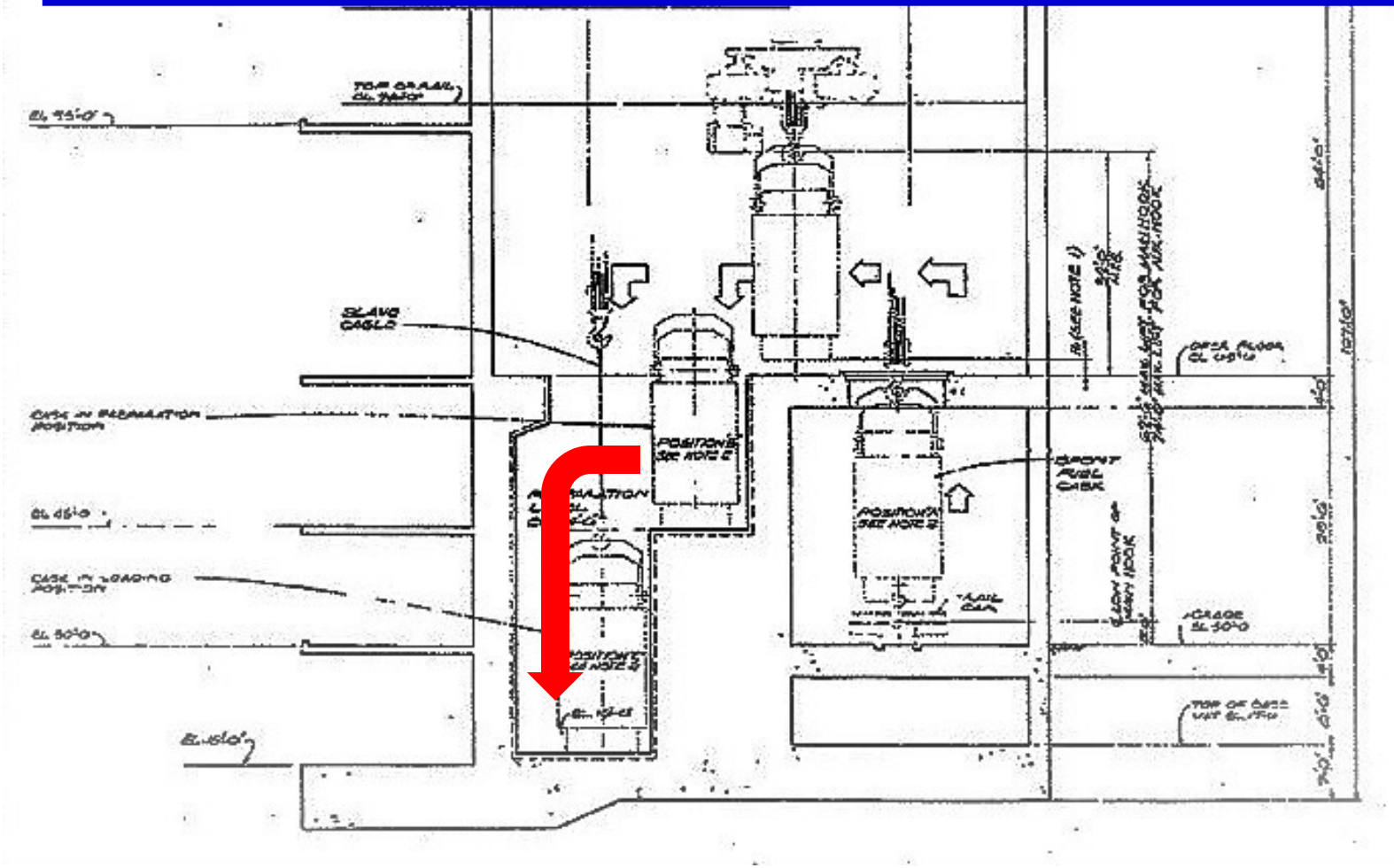
What if the MPC had been dropped?

An MPC cannot be moved over the spent fuel pool. The overhead crane cannot reach that area within the Fuel Handling Building. So, a MPC drop into the spent fuel pool was ruled out at San Onofre.



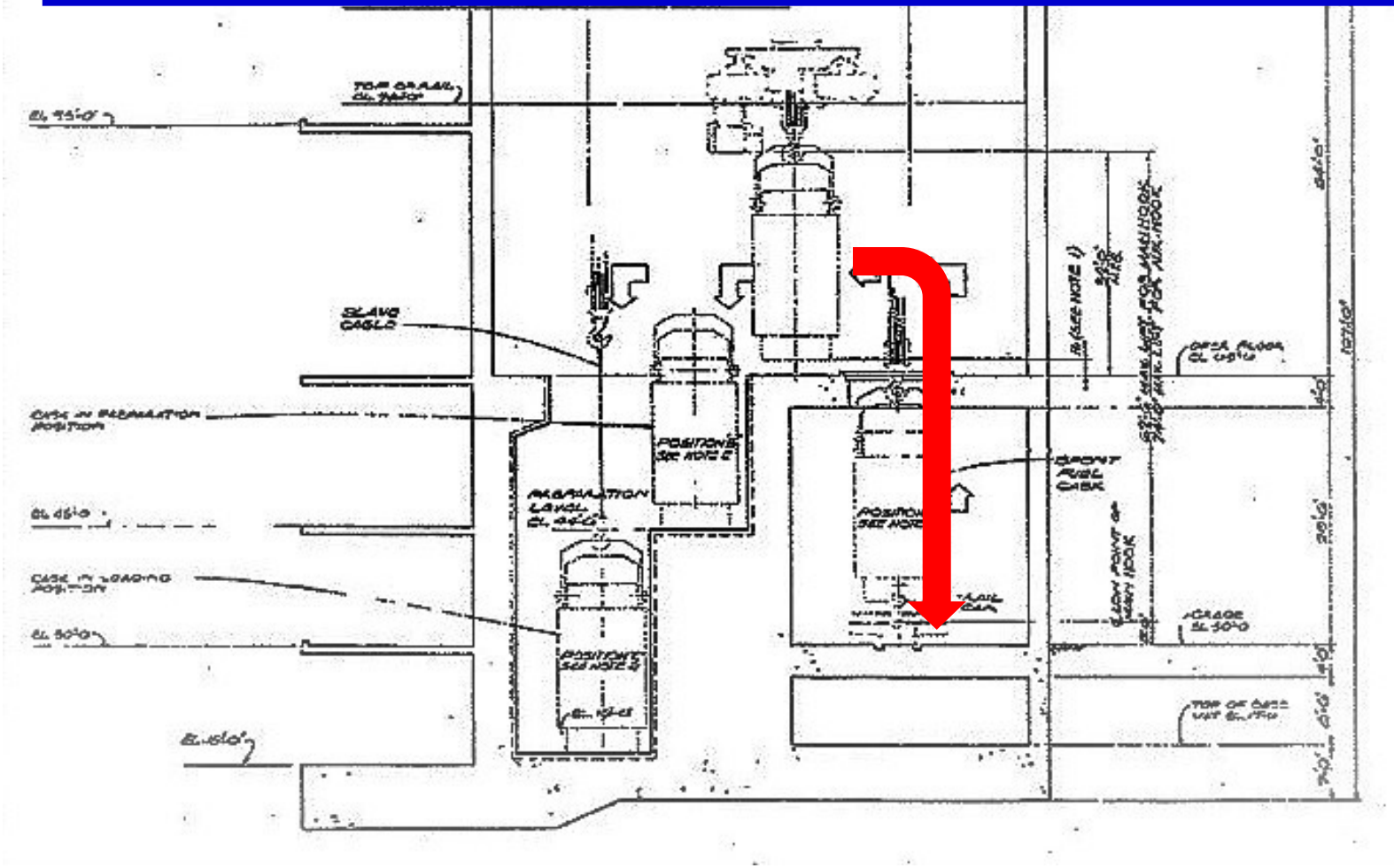
Source: San Onofre Updated Final Safety Analysis Report

An earthquake could shake an MPC off the "step" in the Spent Fuel Cask Storage Pool. An analysis of a drop from the "step" concluded that irradiated fuel inside the MPC might be damaged, but the MPC would remain intact. No radioactivity would be released into the Fuel Handling Building.



Source: San Onofre Updated Final Safety Analysis Report

The 30-foot drop of an MPC onto a flat surface (not likely to still be flat after impact from the 45-ton MPC) was also evaluated. Again, irradiated fuel inside the MPC might be damaged, but the MPC would remain intact to prevent any release of radioactivity.



Source: San Onofre Updated Final Safety Analysis Report

What if the MPC had been dropped?

Evaluations for San Onofre indicate that a dropped MPC might result in damage to irradiated fuel inside, but the MPC would remain intact to prevent the release of radioactivity.

Bottom Line

- **There were redundant measures in place to ensure that the MPC was properly lowered into the CEC.**
- **Both measures failed for different reasons.**
- **The MPC could have fallen about 18 feet.**
- **The fall most likely would not have breached the MPC and released radioactivity.**