

# Suppression Pool Diving Dose Reductions at Limerick Generating Station

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# Typical Suppression Pool Diving Scope

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- Vacuuming (desludging) of underwater surfaces every outage
- Visual and UT inspections of underwater surfaces every other outage
- Debris & condition inspection of ECCS suction strainers
- Spot coating repairs of pitted areas
- Large area preparation and recoating as committed to the NRC for plant life extension
- Removal, inspection, and reinstallation of selected ECCS suction strainers
- Construction and removal of dive and control platforms to support 4 divers (2 per platform)
- Miscellaneous support for setup & demobilization

# Diving Exposure History at Limerick

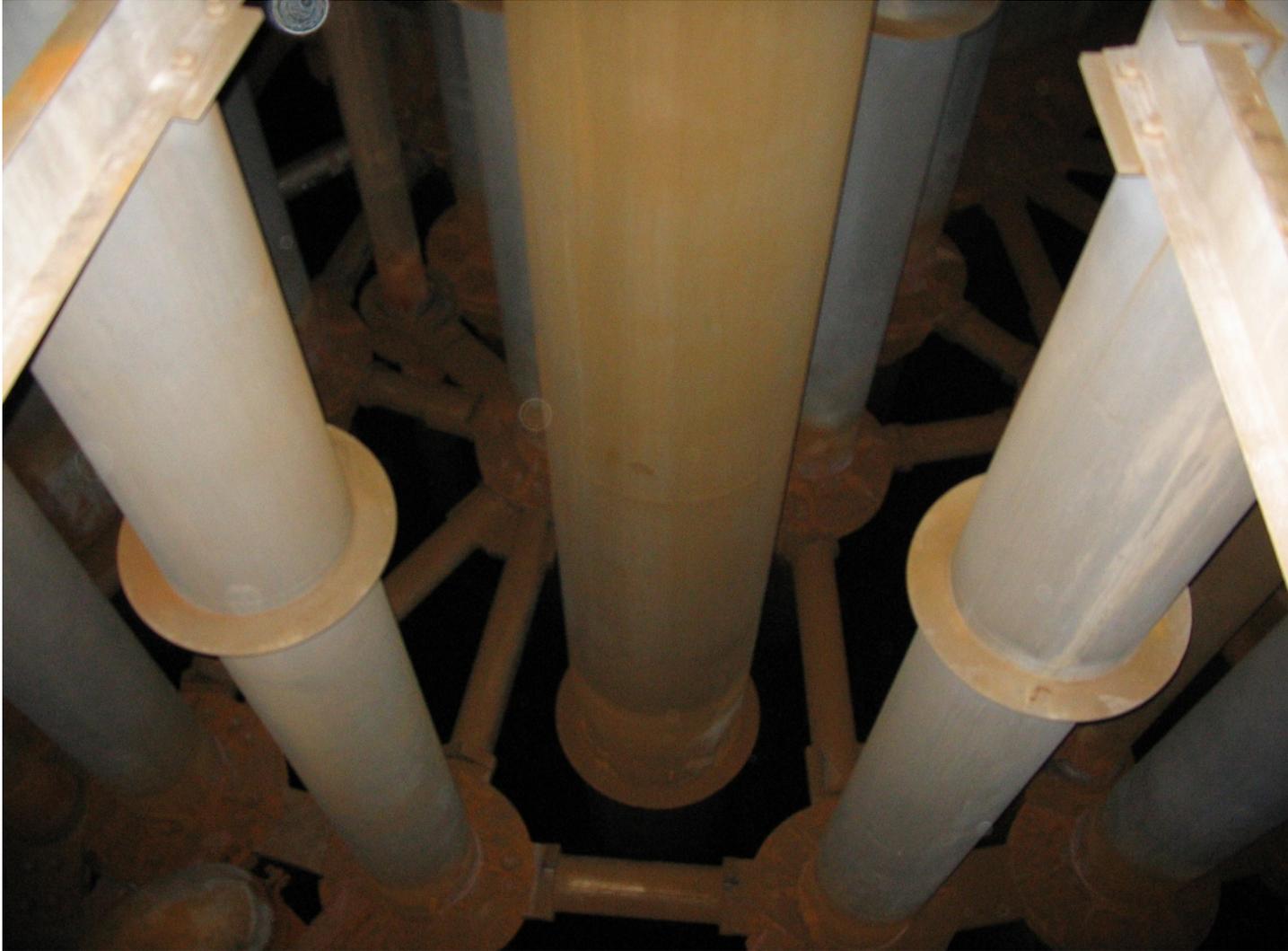
Outage (Year)	Total Dose (Rem)	Average Dose Per Dive (mRem)		# Dives	Underwater Filters					External Filter Usage	Water Level	Dive Platform Type	Work Performed
		Diver	Support		# Filters Used	Filter Disposal Dose (P-Rem)		Filter Dose Rate (R/hr)					
						Catwalk	Diver	Average	Max				
2R10 (2009)	17.118	70	127	56	144	2.8	1.9	7.5	22.6	None	Below Bracing (Low)	Scaffold (Two Platforms)	Full Inspection, 100% Cleaning, Spot Repair
1R13 (2010)	6.305	43	43	35	48	0.7	0.5	7.2	19.2	None	Below Bracing (Low)	Scaffold (One Platform)	50% Cleaning, Minor Spot Repair
2R11 (2011)	No Diving	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No Diving
1R14 (2012)	12.825	35	43	97	78	1.6	0.9	7.1	16.2	<3 hrs for Polishing Only	Below Bracing (Low)	Scaffold (Two Platforms)	Full Inspection, 100% Cleaning, Spot Repair
2R12 (2013)	5.261	23	15	76	72	1.3	0.6	6.5	12.8	3 Days for Polishing Only	Above Bracing (High)	Two Floating Platforms	Full Inspection, 100% Cleaning, Spot Repair
1R15 (2014)	2.667	9	10	68	0	N/A	N/A	N/A	N/A	9 Days for Polishing and Desludge	Above Bracing (High)	Two Floating Platforms	100% Cleaning, 1D C/S Strainer Removal, Spot Repair, Recoat of 938 ft2

# Water Level Effects

- Dose rates with previously submerged structural supports:
  - Contact with surfaces: up to 65 mR/hr
  - Dive platforms 25–45 mR/hr
  - Upper catwalk areas 5-12 mR/hr
  - Requires significant decon of exposed surfaces
    - Power washing using long-handled wands
    - Potential for personnel contamination events
    - Safety concerns

# Exposed Support Bracing

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- Dose rates with highly contaminated structural supports submerged:
  - Contact with surfaces: up to 6 mR/hr
    - Down from 65 mR/hr
  - Dive platforms 2 - 4 mR/hr
    - Down from 25-45 mR/hr
  - Catwalk areas 0.5 - 3 mR/hr
    - Down from 5-12 mR/hr

## Water Management challenges

- Ensure water level remains stable throughout
- Extra 100,000+ gallons of water in the pool causes storage issues
- Need to lower water level to accept reactor cavity drain down later in the outage
- Contingency actions listed in ALARA Plan in the event of water level changes
  - Raised or lowered level affects ladder position
  - Lowered level causes possibility for platform blocks setting directly on bracing supports

# Dive Platform Types

- Requires water level to be below the support bracing to accept scaffold poles and decking
- Higher dose rates on previously submerged surfaces
- High contamination levels on bath tub ring requires carpenters to be in full plastic suits
- Requires significant decontamination
- Safety concerns for initial entry below catwalk level
- Foreign material concerns during removal of dive platforms
- Dose for installation and removal: ~1.25 person-Rem

# Traditional Scaffold Platforms

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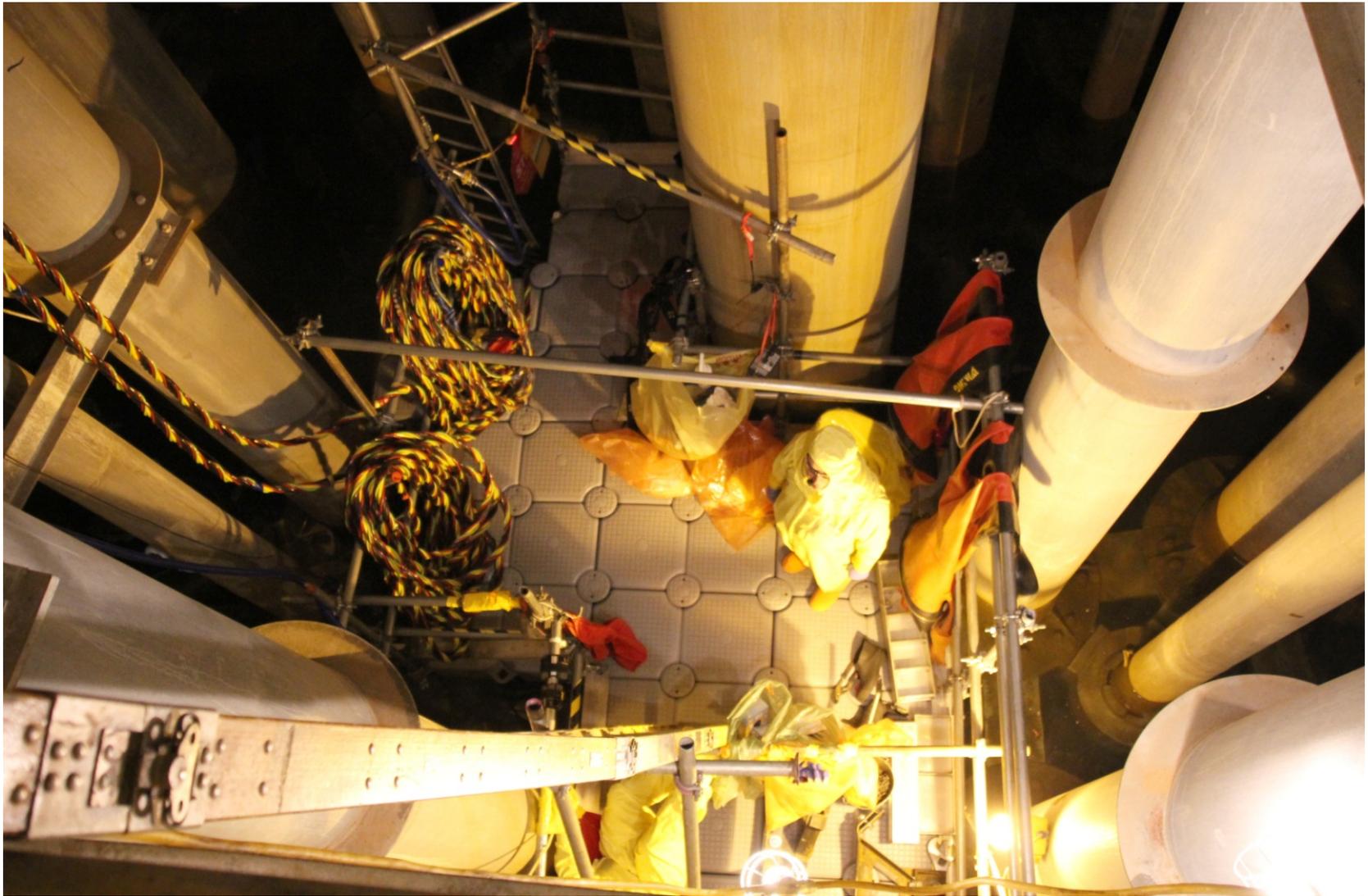
# Traditional Scaffold Platforms



- Normally used in non-nuclear applications
- Can easily construct platforms to any size or shape
- Single block (20 x 20 x 16; 14 lbs) holds up to 220 lbs
- Double block (40 x 20 x 16; 24 lbs) holds up to 400 lbs
- Blow molded, seamless construction, high impact, puncture resistant high density polyethylene
- Weather, chemical, fire and UV resistant
- No leaching or disintegration
- Non-skid surface, no sharp edges, stable work surface
- Partially pre-assemble scaffold material used for railing and dive ladders
- 2 Platforms purchased for under \$5,000 (blocks and connectors)
- Dose for installation and removal: 0.350 person-Rem

# Floating Platforms







- Less workers, time, and dose to construct/remove
- All parts float or can be made to float if dropped
- Mock-ups are recommended and can easily be performed
  - Sections can be pre-assembled then lowered down
  - Needs less than 3 inches of water draft
- Material can be re-used
  - 2013 material disposed of due to high contamination that was not readily removed
  - 2014 material not highly contaminated due to filtration
- Dose for installation & removal ~25% of traditional scaffold

# Floating Platform Mock-up



# Filtration Types

- Permanent plant system
  - Can only be used during plant operation
  - Low flow (350 gpm)
  - Directs water to condenser hotwell
  - Operational restrictions based on suppression pool water temperature

# Underwater Vacuum Filters



- Significant set-up time required
- One vacuum pump has 8 filters (4 or 8 filters replaced based on manifold differential pressure or dose rates)
- Average filter dose rate 7 R/hr contact (max 22.6 R/hr)
- Divers handle each one individually, transporting to hanging storage location (controlled as locked high rad areas)
- RP/Decon personnel manually transport filters from the suppression pool to shipping cask
  - Only 80 filters fit into a cask liner
  - Higher dose rate filters put into center of cask
- Dropped filter(s) require additional dive to retrieve
- “Rock catchers” (strainers) remove debris that can damage pumps

- The Diversified Technologies Services (DTS) Solids Collection Filter (SCF™) system remained in continuous operation for 9 days during diving and desludging
- Three separate underwater desludging pumps connected to 2” cam-lock connections on the DTS designed submersible pump suction shroud (3 open ports for water polishing)
- Submersible pump maintained > 500 gpm even when filters were loaded from suppression pool desludging work
- System d/P was maintained <35 psid by shutting down the transfer pump for short periods (less than 20 minutes every 4-5 hours)
- Total throughput was 5,586,000 gallons by totalizer readings
- Water clarity maintained > 3 feet with as much as 12-18’ visibility

- Used 2 micron filtration media
- Spare filter on site but not needed
- 6” Piping/hoses with cam-lock fittings to/from filter
- Inlet hose shielded (max 7 mR/hr contact below shield)
- Reduced water activity led to lower contamination levels on platform sections and diver umbilical cords
- The single SCF replaced the need for up to 80 underwater vacuum filters during desludging
- Remote radiation monitors placed at top and side of cask to monitor for high rad areas and shipping restrictions

# Diversified Technologies Services SCF™ Filter 24

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# Diversified Technologies Services SCF™ Filter 25

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# External Filter Shielding



- Install dive control stations outside of suppression pool
  - Easier construction in radiologically “clean” area
  - Can be constructed and outfitted before suppression pool opened
  - Gets divers in water faster once floating platforms installed and outfitted
- Construct only one (larger) dive platform that can handle up to 4 divers
- Potential for charcoal filter to reduce TOC leached from coating material
- Do not drain reactor cavity water to suppression pool
- Evaluate mod for permanent dive platforms

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