DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

RCRA Corrective Action
Environmental Indicator (EI) RCRIS code (CA725)
Current Human Exposures Under Control

Facility Name: **Virginia Polytechnic Institute and State University (Virginia Tech)**
Facility Address: **459 Tech Center Drive (0423), Blacksburg, Virginia 24061**
Facility EPA ID #: **VAD074747908**

1. Has **all** available relevant/significant information on known and reasonably suspected releases to soil, groundwater, surface water/sediments, and air, subject to RCRA Corrective Action (e.g., from Solid Waste Management Units (SWMU), Regulated Units (RU), and Areas of Concern (AOC)), been **considered** in this EI determination?

☒ If yes - check here and continue with #2 below.

☐ If no - re-evaluate existing data, or

☐ if data are not available, skip to #8 and enter "IN" (more information needed) status code.

BACKGROUND

Definition of Environmental Indicators (for the RCRA Corrective Action)

Environmental Indicators (EI) are measures being used by the RCRA Corrective Action program to go beyond programmatic activity measures (e.g., reports received and approved, etc.) to track changes in the quality of the environment. The two EI developed to-date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater. An EI for non-human (ecological) receptors is intended to be developed in the future.

Definition of "Current Human Exposures Under Control" EI

A positive "Current Human Exposures Under Control" EI determination ("YE" status code) indicates that there are no "unacceptable" human exposures to "contamination" (i.e., contaminants in concentrations in excess of appropriate risk-based levels) that can be reasonably expected under current land- and groundwater-use conditions (for all "contamination" subject to RCRA corrective action at or from the identified facility (i.e., site-wide)).

Relationship of EI to Final Remedies

While Final remedies remain the long-term objective of the RCRA Corrective Action program the EI are near-term objectives which are currently being used as Program measures for the Government Performance and Results Act of 1993, GPRA). The "Current Human Exposures Under Control" EI are for reasonably expected human exposures under current land- and groundwater-use conditions ONLY, and do not consider potential future land- or groundwater-use conditions or ecological receptors. The RCRA Corrective Action program's overall mission to protect human health and the environment requires that Final remedies address these issues (i.e., potential future human exposure scenarios, future land and groundwater uses, and ecological receptors).

Duration / Applicability of EI Determinations

EI Determinations status codes should remain in RCRIS national database ONLY as long as they remain true (i.e., RCRIS status codes must be changed when the regulatory authorities become aware of contrary information).

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2. Are groundwater, soil, surface water, sediments, or air **media** known or reasonably suspected to be **"contaminated"**[1] above appropriately protective risk-based "levels" (applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action (from SWMUs, RUs or AOCs)?

	Yes	No	?	Rationale / Key Contaminants
Groundwater	X			See explanation below[(a)]
Air (indoors)[2]		X		
Surface Soil (e.g., <2 ft)		X		See explanation below[(a)]
Surface Water		X		See explanation below[(b)]
Sediment		X		
Subsurf. Soil (e.g., >2 ft)	X			See explanation below[(a)]
Air (outdoors)		X		

☐ If no (for all media) - skip to #6, and enter "YE," status code after providing or citing appropriate "levels," and referencing sufficient supporting documentation demonstrating that these "levels" are not exceeded.

☒ If yes (for any media) - continue after identifying key contaminants in each "contaminated" medium, citing appropriate "levels" (or provide an explanation for the determination that the medium could pose an unacceptable risk), and referencing supporting documentation.

☐ If unknown (for any media) - skip to #6 and enter "IN" status code.

Rationale and Reference(s):

(a) Soil and/or groundwater at Virginia Tech are known to be impacted at the following Solid Waste Management Units (SWMUs) and Areas of Concern (AOC):

- SWMU 1 – Former Physical Plant Area
- SWMU 2 – Closed Sanitary Landfill (Virginia Department of Environmental Quality (VDEQ) Permit No. 109)
- AOC 5 – 2002 VT Power Plant Fuel Release.

SWMU 1 – Former Physical Plant Area

SWMU 1 is located in the area between Cowgill Hall and the Perry Street Parking lot near Whittemore Hall and includes the area where the Bishop-Favro building currently stands. SWMU 1 encompasses the area that was the Former Physical Plant Area from 1935 to 1968. The Former Physical Plant was comprised of various buildings and provided maintenance for university buildings and equipment. In addition, a former quarry that supplied building stone used on campus during the early part of the 20th century was located adjacent to the Former Physical Plant in the area behind Derring and Cowgill Halls. The former quarry is believed to have operated from 1899 to 1935. The former quarry reportedly was filled with water from 1935 until the late 1940's, and was subsequently filled with soil and other fill material from the late 1940's until 1952. The area of the former quarry is currently covered by asphalt, various buildings, and grassy areas. Due to uncertainty regarding the methods by which the former quarry was filled, as well as the waste handling procedures that were used at the Former Physical Plant Area, VA Tech conducted extensive site assessments of these areas in 1993 and 2002. The site assessments included geophysical surveys, in addition to soil and groundwater sampling.

Soil Samples:
Subsurface soil investigations found that fill materials in the former quarry consisted of soil, organic soils, gravel, rock fragments, coal, ash, cinders, and various debris (spares bricks, wood, concrete, glass, and metal). The analytical results for soil samples collected in 1993 and 2002 detected nine metals, 17 volatile organic compounds (VOCs), and

18 SVOCs. As part of the 2002 investigation, the results of detected constituents were compared to VADEQs Tier II and Tier III Voluntary Remediation Program (VRP) screening levels. Tier II screening levels are applicable for unrestricted use of the site (e.g., residential use). Tier III screening levels are risk-based concentrations based on EPA Region III Risk Screening Levels (RSLs) for commercial/industrial exposures or the EPA Soil Screening Levels (SSLs) guidance for transfer from soil to air. The results for the soil analyses and screening are discussed as follows:

Metals:
Arsenic concentrations ranged from 5.55 mg/kg to 10.4 mg/kg, which exceeded the Tier II screening level of 0.43 mg/kg and the Tier III screening level of 3.8 mg/kg. However, the levels of arsenic detected are representative of background levels (6.68 to 10.3 mg/kg) based on a statistical comparison of on-site arsenic levels to background.

Barium concentrations ranged from 40.2 mg/kg to 648 mg/kg, and one sample exceeded the Tier II screening level of 550 mg/kg, but did not exceed the Tier III screening level of 14,000 mg/kg.

Chromium concentrations ranged from 6.3 mg/kg to 24.7 mg/kg, which exceeded the Tier II screening level of 4.2 mg/kg, but not the Tier III screening level of 610 mg/kg. The residential exposure screening level for chromium is 23 mg/kg, which is based on hexavalent chromium.

Lead concentrations ranged from 5.8 mg/kg to 648 mg/kg, and two samples exceeded the Tier II screening level of 400 mg/kg, but did not exceed the Tier III screening level of 1,000 mg/kg.

Cadmium, mercury, selenium, silver, and zinc concentrations did not exceed the Tier II screening levels.

VOCs:
VOCs were generally detected at very low concentrations. Many of the VOCs were detected with the field GC analyses in 1993 for the Geoprobe samples. Only two VOC results exceeded Tier II screening levels and both were for a sample collected near an area where hazardous materials were removed in 1988 during the installation of a storm water line. The first compound was methylene chloride at a concentration of 0.19 mg/kg, which exceeded the Tier II screening level of 0.023 mg/kg, but not the Tier III screening level of 17 mg/kg. The second compound was 1,1,2,2-tetrachloroethane at a concentration of 0.01 mg/kg, which exceeded the Tier II screening level of 0.0033 mg/kg, but not the Tier III screening level of 0.77 mg/kg. Both of these Tier II screening levels are based on soil-to-groundwater screening levels.

SVOCs:
The Semi-Volatile Organic Compounds (SVOCs) detected were in the category of polynuclear aromatic hydrocarbons (PAHs) and are likely associated with the cinders and ash encountered in the borings. Out of the 18 SVOCs detected, only two exceeded the Tier II screening levels. Benzo(b)fluoranthene concentrations ranged from less than 0.204 mg/kg to 0.895 mg/kg, and one sample exceeded the Tier II screening level of 0.87 mg/kg, but did not exceed the Tier III screening level of 7.8 mg/kg. Benzo(a)pyrene concentrations ranged from less than 0.204 mg/kg to 0.685 mg/kg, and two samples exceeded the Tier II screening level of 0.087 mg/kg, but did not exceed the Tier III screening level of 0.78 mg/kg.

Groundwater Samples:
The laboratory results for groundwater samples collected in 1993 and 2002 indicated 11 metals and one VOC. As part of the 2002 investigation, the results of detected constituents in groundwater were compared to VADEQs Tier II and Tier III VRP screening levels.

Metals:
Barium concentrations detected during the 2002 sampling event generally ranged from 0.0736 mg/L to 0.214 mg/L, which did not exceed the Tier II screening level of 2.0 mg/L. However, one sample (well MW-5) had a barium concentration of 3.75 mg/L, which exceeded the Tier II screening level of 2.0 mg/L, but did not exceed the Tier III screening level of 36.8 mg/L. Well MW-5 is located in a parking lot and the well cap was loose at the time of sampling, meaning the well may have been impacted by run-off during the years between sampling. Also, the groundwater purged from well MW-5 was grayish and turbid. It should be noted that metals results can be influenced by high turbidity in groundwater samples. Therefore, the barium concentrations for well MW-5 may not be representative. The groundwater samples obtained in 1993 were not analyzed for barium.

Chromium concentrations ranged from less than 0.001 mg/L to 0.185 mg/L, and one sample exceeded the Tier II screening level of 0.100 mg/L, but did not exceed the Tier III screening level of 2.69 mg/L. The sample exceeding the Tier II screening level was collected in 1993 from well MW-7, which was reported to be turbid. Well MW-7 could not be located for resampling in 2002.

Lead concentrations in 1993 ranged from less than 0.001 mg/L to 0.263 mg/L, and samples from four wells exceeded the Tier II screening level of 0.015 mg/L. A Tier III screening level is not established for lead in groundwater. The sample with the highest concentration was from well MW-7, which was turbid and could not be resampled in 2002. The sample with the second highest concentration at 0.056 mg/L was upgradient well MW-1. The other two sample locations with lead concentrations exceeding the Tier II screening level were well MW-2, which could not be located to be resampled in 2002, and the grab sample from Geoprobe boring CC-1, which was a turbid sample. The 2002 lead results for wells MW-1, MW-3A, MW-4 and MW-5 were less than the Tier II screening level.

Nickel concentrations ranged from 0.00175 mg/L to 0.25 mg/L, and one sample exceeded the Tier II screening level of 0.073 mg/L, but did not exceed the Tier III screening level of 12.8 mg/L. The sample exceeding the Tier II screening level was from well MW-7 in 1993. As previously stated, that well was reported to be turbid and could not be located to be resampled in 2002.

Arsenic, beryllium, cadmium, copper, selenium, silver, and zinc concentrations did not exceed the Tier II screening levels.

VOCs:
The only VOC detected in either the 1993 or 2002 groundwater sampling events was chloroform in upgradient wells MW-1 and MW-6. The concentrations ranged from 0.004 mg/L to 0.027 mg/L, which do not exceed the Tier II screening level of 0.100 mg/L.

Additional Groundwater Sampling:
Of the seven monitoring wells that were part of the 1993 and 2002 site investigations of SWMU 1, only two wells remain; upgradient wells MW-1 and MW-6. The other five wells were either inadvertently destroyed or paved over during construction activities and could not be located. In November 2010, Virginia Tech conducted additional sampling and analyses of the two remaining wells. From the extensive list of constituents tested for (metals, VOCs, SVOCs including PAHs), only five constituents were detected in groundwater at well MW-6 at very low concentrations; no constituents were detected in well MW-1. Four of the five detected constituents were detected at concentrations less than 0.001 mg/L. Chloroform was detected at a concentration of 0.0044 mg/L, well below the Tier II screening level of 0.08 mg/L.

SWMU 2 – Closed Sanitary Landfill (Virginia Department of Environmental Quality (VDEQ) Permit No. 109)

SWMU 2 is a closed solid waste landfill located to the west of Route 460 Bypass and to the north of Prices Fork Road. On May 30, 1973, the Virginia Department of Health issued Solid Waste Permit No. 109 for this approximately 4.5 acre unlined sanitary landfill. During operation of the landfill, Virginia Tech disposed of general university waste within eight trenches that were constructed without a base liner or leachate collection system. Additionally, asbestos waste was disposed within one well-defined section of the landfill.

Trenches 1 through 6 were closed prior to 1988, and trenches 7 and 8 were closed in 1994. Landfill gas monitoring and groundwater detection monitoring were initiated for the landfill in 1992. Constituents for which groundwater concentrations currently exceed applicable regulatory threshold levels (VADEQ approved groundwater protection standards (GPS)) at SWMU 2 and their maximum concentrations observed on the most recent (May 2010) corrective action monitoring event are as follows:

- 1,1-Dichloroethane – 11 µg/l (MW-3) compared to GPS (1.878 µg/l)
- Arsenic – 13.9 µg/l (MW-2) compared to GPS (10 µg/l)
- Cobalt – 21.2 µg/l (MW-4) compared to GPS (4.695 µg/l)
- Vinyl Chloride - 11 µg/l (MW-3) compared to GPS (2.0 µg/l)

AOC 5 – 2002 Virginia Tech Power Plant Fuel Release

In December 2002, Virginia Tech detected a fuel release from its two 137,000-gallon cast-in-place concrete underground storage tanks (USTs) which share a common center wall. The source of the release was determined to be a perforation in the eastern wall of the UST. Prior to July 2002, the USTs were used to store No. 6 fuel oil, which was used to operate the boilers in the Power Plant. The boilers were shifted to use No. 2 fuel oil and, as a result, the USTs were retrofitted in July 2002 to store No. 2 fuel oil.

In response to the release, VADEQ requested Virginia Tech to conduct a site risk and remediation assessment. Soil and groundwater sample results for total petroleum hydrocarbons (TPH) – diesel range organics (DRO) from December 2002/January 2003, in addition to site characterization activities conducted in May 2003, indicated that the petroleum impact appeared to be limited to a soil depth of 12-18 feet below ground surface (bgs) in the vicinity of vent well VW-1, and soil borings B-1, B-2, and B-4, and covered an estimated area of approximately 670 square feet. Contaminant concentrations detected during site characterization are as follows:

Boring Soil Sample Analytical Results		
Soil Sample ID (Depth)	TPH-DRO Concentration (mg/kg)	Naphthalene Concentration (mg/kg)
B-1 (14-15')	390	NA
B-1 (17-17.5')	1,700	0.7
B-2 (16.5')	3,900	NA
B-4 (13-15')	5,400	2.6

Liquid Sample Analytical Results for well VW-1	
Constituent	Sample Result (mg/L)
TPH-DRO	911,000
2-Methylnaphthalene	49,200
Naphthalene	13,400

In March 2004, approximately 143 tons of impacted soil adjacent to the eastern wall of the UST was removed. Further excavation beyond the northwest corner of the tank wall was prohibited due to the close proximity to a buried utility line; therefore, some contaminated soil was left in place. A 16-inch diameter monitoring and recovery sump was placed in the excavation and backfilled to facilitate further product recovery. The perforation in the UST was located and temporarily repaired by Virginia Tech to eliminate the source of the release.

At AOC 5, minimal amounts of free product are observed in the vault sump, and no free product is typically observed in the groundwater well VW-1. A small sheen is observed at times in VW-1, however this well is not believed to monitor true groundwater at the site (true groundwater aquifer is inferred to reside in the deeper bedrock and not believed to be impacted from this site).

(b) Several minor releases to surface water have occurred over the years at Virginia Tech. Due to the topography of the Blacksburg Area, the Duck Pond on the Virginia Tech campus receives waters from storm water sewers and runoff from streets and properties throughout the Town of Blacksburg (including the Virginia Tech campus). Two branches of Stroubles Creek flow through parts of the Virginia Tech campus and drain into the Duck Pond, which is located on the western edge of campus.

Stroubles Creek is listed as an impaired waterway for biological activity due to non-point source activities such as agriculture, storm-water runoff, and erosion. The impaired stream segment on Stroubles Creek, as delineated by the VADEQ, extends from the outlet of the Duck Pond to the confluence of Wall Branch to the west. Virginia Tech and VADEQ have initiated corrective measures for Stroubles Creek, including monitoring and construction of water quality ponds. In addition, the Town of Blacksburg's Creek Valley Overlay District protects the riparian corridors which are most susceptible to soil erosion and runoff along Stroubles Creek (Blacksburg Comprehensive Plan, 2006). A TMDL Implementation Plan for the Upper Stroubles Creek Watershed was approved by VADEQ on May 24, 2006. The TMDL Plan may be accessed for review and use at the following VADEQ website: http://www.deq.virginia.gov/tmdl/apptmdls/newrvr/stroub.pdf

References:

1. Dewberry & Davis Draft Interim Report for Cowgill Hall/Former Physical Plant Investigation (Volumes 1 & 2), June 1993
2. Dewberry & Davis Final Report for Cowgill Hall/Former Physical Plant Investigation (Volume 3 – Addendum No. 1, Second Phase Investigations Report & Appendices), October 1993
3. Engineering Consulting Services, Ltd. (ECS) Voluntary Remediation Site Characterization Report, Former Quarry/Physical Plant, September 2002
4. Annual Groundwater Monitoring Report, Closed Virginia Tech Sanitary Landfill, February 2010
5. Correspondence from Virginia Tech to VADEQ Requesting a Minor Permit Amendment for the Closed Sanitary Landfill, November 2010
6. Post Site Characterization Report, Virginia Tech Power Plant, Corner of Turner Street and Barger Street, November 2009
7. Quarterly Post Site Characterization Report, Virginia Tech Power Plant, Corner of Turner Street and Barger Street, November 2010
8. Description of Current Conditions, Virginia Polytechnic Institute and State University, December 2010

Footnotes:

[1] "Contamination" and "contaminated" describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriately protective risk-based "levels" (for the media, that identify risks within the acceptable risk range).

[2] Recent evidence (from the Colorado Dept. of Public Health and Environment, and others) suggest that unacceptable indoor air concentrations are more common in structures above groundwater with volatile contaminants than previously believed. This is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration necessary to be reasonably certain that indoor air (in structures located above (and adjacent to) groundwater with volatile contaminants) does not present unacceptable risks.

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3. Are there **complete pathways** between "contamination" and human receptors such that exposures can be reasonably expected under the current (land- and groundwater-use) conditions?

Summary Exposure Pathway Evaluation Table

Potential **Human Receptors** (Under Current Conditions)

"Contaminated" Media	Residents	Workers	Day-Care	Construction	Trespassers	Recreation	Food[3]
Groundwater	**No**	**No**	**No**	**No**	**No**	**No**	**No**
~~Air (indoors)~~							
~~Soil (surface, e.g., <2 ft)~~							
~~Surface Water~~							
~~Sediment~~							
Soil (subsurface e.g., >2 ft)	**No**	**No**	**No**	**No**	**No**	**No**	**No**
~~Air (outdoors)~~							

Instructions for Summary Exposure Pathway Evaluation Table:

1. Strike-out specific Media including Human Receptors' spaces for Media which are not "contaminated" as identified in #2 above.

2. enter "yes" or "no" for potential "completeness" under each "Contaminated" Media -- Human Receptor combination (Pathway).

Note: In order to focus the evaluation to the most probable combinations some potential "Contaminated" Media - Human Receptor combinations (Pathways) do not have check spaces ("___"). While these combinations may not be probable in most situations they may be possible in some settings and should be added as necessary.

☒ If no (pathways are not complete for any contaminated media-receptor combination) - skip to #6, and enter "YE" status code, after explaining and/or referencing condition(s) in-place, whether natural or man-made, preventing a complete exposure pathway from each contaminated medium (e.g., use optional Pathway Evaluation Work Sheet to analyze major pathways).

☐ If yes (pathways are complete for any "Contaminated" Media - Human Receptor combination) - continue after providing supporting explanation.

☐ If unknown (for any "Contaminated" Media - Human Receptor combination) - skip to #6 and enter "IN" status code.

Rationale and Reference(s):

Based on site use conditions and site hydrogeology, no uncontrolled temporary exposure pathways are known to exist or are likely in the future. Remedial actions and groundwater monitoring are ongoing at this site in accordance with VADEQ programs. Overall, groundwater is not currently used as a potable or irrigation water supply at Virginia Tech; potable water is supplied to the facility and the surrounding area by the Blacksburg-Christiansburg-VPI Water Authority and withdrawn from the New River (intake is located approximately 5 to 6 miles from the Virginia Tech campus). As for contaminated soils in the vicinity of SWMU 1, any further development in this area will be in accordance with a materials management plan between Virginia Tech and VADEQ.

[3] Indirect Pathway/Receptor (e.g., vegetables, fruits, crops, meat and dairy products, fish, shellfish, etc.)

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4. Can the **exposures** from any of the complete pathways identified in #3 be reasonably expected to be **"significant"**[4] (i.e., potentially "unacceptable" because exposures can be reasonably expected to be: 1) greater in magnitude (intensity, frequency and/or duration) than assumed in the derivation of the acceptable "levels" (used to identify the "contamination"); or 2) the combination of exposure magnitude (perhaps even though low) and contaminant concentrations (which may be substantially above the acceptable "levels") could result in greater than acceptable risks)?

☐ If no (exposures can not be reasonably expected to be significant (i.e., potentially "unacceptable") for any complete exposure pathway) - skip to #6 and enter "YE" status code after explaining and/or referencing documentation justifying why the exposures (from each of the complete pathways) to "contamination" (identified in #3) are not expected to be "significant."

☐ If yes (exposures could be reasonably expected to be "significant" (i.e., potentially "unacceptable") for any complete exposure pathway) - continue after providing a description (of each potentially "unacceptable" exposure pathway) and explaining and/or referencing documentation justifying why the exposures (from each of the remaining complete pathways) to "contamination" (identified in #3) are not expected to be "significant."

☐ If unknown (for any complete pathway) - skip to #6 and enter "IN" status code

Rationale and Reference(s):

N/A

[4] If there is any question on whether the identified exposures are "significant" (i.e., potentially "unacceptable") consult a human health Risk Assessment specialist with appropriate education, training and experience.

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5. Can the "significant" **exposures** (identified in #4) be shown to be within **acceptable** limits?

☐ If yes (all "significant" exposures have been shown to be within acceptable limits) - continue and enter "YE" after summarizing and referencing documentation justifying why all "significant" exposures to "contamination" are within acceptable limits (e.g., a site-specific Human Health Risk Assessment).

☐ If no - (there are current exposures that can be reasonably expected to be "unacceptable")- continue and enter "NO" status code after providing a description of each potentially "unacceptable" exposure.

☐ If unknown (for any potentially "unacceptable" exposure) - continue and enter "IN" status code.

Rationale and Reference(s):

N/A

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6. Check the appropriate RCRIS status codes for the Current Human Exposures Under Control EI (event code CA725), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (attach appropriate supporting documentation as well as a map of the facility).

☒ YE - Yes, "Current Human Exposures Under Control" has been verified. Based on a review of the information contained in this EI Determination, "Current Human Exposures" are expected to be "Under Control" at the Virginia Polytechnic and State University facility, EPA ID # VAD074747908, located at 459 Tech Center Drive, Blacksburg, Virginia 24061 under current and reasonably expected conditions. This determination will be re-evaluated when the Agency/State becomes aware of significant changes at the facility.

☐ NO - "Current Human Exposures" are NOT "Under Control."

☐ IN - More information is needed to make a determination.

Completed by (signature) _____ Date 3/17/2011

(print) Jeanna R. Henry
Remedial Project Manager
Office of Pennsylvania Remediation
EPA Region III

Supervisor (signature) _____ Date 3/21/2011

(print) Luis Pizarro
Associate Director
Office of Remediation
EPA Region III

Locations where References may be found:

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