DOE-0431
Revision 0

RECOMMENDATIONS FOR INSTITUTIONAL CONTROL TIME PERIOD FOR CONDUCTING DOE ORDER 435.1 PERFORMANCE ASSESSMENTS AT THE HANFORD SITE

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

P.O. Box 450
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

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Date Published
October 2019

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P.O. Box 450
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APPROVED
By Janis D. Aardal at 9:09 am, May 05, 2020

Release Approval Date

Approved for Public Release;
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October 7, 2019

Approved for Public Release;
Further Dissemination Unlimited

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RECOMMENDATIONS FOR INSTITUTIONAL CONTROL TIME PERIOD FOR CONDUCTING DOE ORDER 435.1 PERFORMANCE ASSESSMENTS AT THE HANFORD SITE

The U.S. Department of Energy (DOE) at the Hanford Site has a number of facilities (Low Level Burial Grounds, Environmental Restoration Disposal Facility [ERDF], Integrated Disposal Facility [IDF], seven Waste Management Areas (WMA) containing 12 single-shell tank farms, and six double-shell tank farms) requiring a DOE O 435.1 performance assessment (PA). The fundamental objective of the PA is to estimate potential radiological dose to receptors from releases from a closed facility containing radioactive waste. The PA evaluates the following:

1) Release of contaminants of potential concern at the source, transport through the environment, and exposure to humans
2) Exposure to potential receptors who could inadvertently intrude into the residual waste left in the facility.

Exposure due to release and environmental transport of the COPCs (for the groundwater pathway) is usually on the order of hundreds to thousands of years after release, while exposure due to inadvertent intrusion begins after the institutional control (IC) period.

RECOMMENDATION

This white paper proposes using a consistent year along with sensitivity analyses for the end of the IC period for inadvertent intrusion analyses across all PAs at Hanford based on existing *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) and *Resource Conservation and Recovery Act of 1976* (RCRA) decision documents requiring ICs as part of the selected remedy.

It is recommended that identified end of institutional controls in the *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions and RCRA Corrective Actions* (DOE/RL-2001-41 Rev 9), *Record of Decision Hanford 100 Area Superfund Site for 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units* (EPA 2014), *Record of Decision Hanford 200 Area 200-ZP-1 Superfund Site Benton County Washington* (EPA 2008), *Record of Decision Hanford 100 Area Superfund Site 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units* (EPA 2018) provide the basis for the removal of ICs for the low-level waste disposal facilities PAs at Hanford. Year 2278, which is indicated in *Record of Decision Hanford 100 Area Superfund Site for 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units* (EPA 2014) represents the longest period of institutional controls in the DOE/RL-2001-41. Therefore, it is recommended that the impacts from inadvertent intrusion for the ongoing PAs be evaluated after calendar year 2278.

For PAs that will be performed in the future, it is recommended that the most current version of the DOE/RL-2001-41 be used for establishing the technical basis for the end of the institutional control period for evaluating the impacts from inadvertent intrusion.

Although not required, it is recommended that PAs consider performing additional sensitivity analyses to evaluate dose from inadvertent intrusion at other assumed end of institutional control dates.

The following points provide the reasoning for these recommendations:

1) Record of Decisions and DOE/RL-2001-41 require the maintenance of the ICs as part of the selected remedy until such time that they can be removed. Thereby, ensuring ongoing work at the Hanford site.
2) Removal of ICs covered by the Record of Decision cannot be accomplished unless EPA or Washington Department Ecology authorizes it (Section 12 [EPA 2018]), or EPA authorizes the removal of ICs (Section 12 [EPA 2008]) and (Section 12 [EPA 2014]).
3) Year of removal of ICs have been incorporated into DOE/RL-2001-41 and Records of Decisions signed by all three members of HFFACO
4) The likelihood of year of removal of ICs changing is small as compared to closure of low-level waste disposal facility in work schedules or changes within HFFACO
5) Provides a consistent date for removal of ICs across all low-level waste facilities' PAs at the Hanford Site
6) Additional sensitivity analyses provide risk management –information on inadvertent intrusion if access of the public in selected areas of the Hanford Site is allowed earlier.

Furthermore, DOE plans to turn the site over to DOE's Legacy Management (LM) for long term stewardship (LTS) following the completion of all cleanup activities. The scope of LTS is operation and maintenance of Hanford Site infrastructure following cleanup activities, environmental monitoring of groundwater, soil, vadose zone, and monitoring for public safety and resource protection, planning, land management, and surveillance and maintenance activities to ensure environmental compliance and protection, payment in lieu of taxes, and management and administration.

BACKGROUND INFORMATION

INSTITUTIONAL CONTROLS

Institutional controls are mechanisms to prevent inappropriate uses of land, facilities, and environmental media and to prevent unacceptable human health and environmental exposure to residual contaminants that could pose risks above levels deemed protective. ICs generally include non-engineered restrictions on activities and access to land, groundwater, surface water, waste sites, waste disposal areas, and other areas or media that may contain radionuclides/ hazardous substances to minimize the potential for human exposure to the substances.

For DOE 435.1 PAs at low-level waste disposal facilities, the *Implementation Guide for use with DOE M 435.1-1* Chapter 4 "Low-Level Waste Requirements" (DOE G 435.1-1) states the following:

> *"In the intruder assessment, institutional controls should be assumed to be effective in preventing intrusion for at least 100 years following disposal facility closure; longer periods may be assumed with justification (e.g., land-use planning, passive controls)."*

Typically, it is assumed that the scheduled closure date of the low-level waste disposal facility is the start of IC period. That assumption for single low-level waste disposal facility is defensible. Conversely, at DOE sites such as Hanford, Savannah, Oak Ridge, etc., that assumption is not appropriate, because at these DOE sites, the process of clean-up and operations will continue for a number of years beyond the assumed closure date of any one specific low-level waste disposal facility located within the boundaries of these sites. The public would not have access to the land around a closed single low-level waste disposal facility as long as clean-up and operations are continuing on the site and for an uncertain period of time after those operations have ceased.

The Hanford Site has produced an institutional control plan (DOE/RL-2001-41) since 2002. This plan summarizes the ICs for the Hanford Site required by decision documents; and how they are implemented and maintained in accordance with the following policy, laws, and regulations:

- DOE Policy 454.1, *Use of Institutional Controls*[1]

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[1] DOE P 454.1, 2003, *Use of Institutional Controls*, U.S. Department of Energy, Washington, D.C.

- *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*[2] (CERCLA)
- *Superfund Amendments and Reauthorization Act of 1986*[3]
- Title 40 *Code of Federal Regulations* (CFR) Part 300, "National Oil and Hazardous Substances Pollution Contingency Plan (NCP)"
- *Resource Conservation and Recovery Act of 1976*[4] (RCRA) and the *Hazardous Waste Management Act* (Revised Code of Washington 70.105, "Hazardous Waste Management") as implemented through Washington Administrative Code 173-303, "Dangerous Waste Regulations."

CERCLA decision documents present the selected remedial actions chosen in accordance with CERCLA, 40 CFR 300, and implementing documents such as remedial design reports and remedial action work plans that have IC requirements. RCRA decision documents describe the closure and corrective actions selected under RCRA. These documents are part of the cleanup mission at the Hanford Site. The selected remedies/corrective actions chosen under CERCLA or RCRA may include ICs.

The institutional control plan is required by the 100 Area record of decision (ROD) (EPA/ROD/R10-00/121[5]), 2001 CERCLA 5-Year Review (EPA [2001a]), 300 Area ROD (EPA/ROD/R10-01/119[6]) and Hanford Comprehensive Land-Use Plan Environmental Impact Statement (DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*[7]). The Plan is updated when CERCLA decision documents and/or RCRA corrective-action documents listing new ICs are issued. Since the Plan's initial release in July of 2002, it has been revised nine times with the most recent revision being released in February 2019. It is signed by all signatories of the "Hanford Federal Facility Agreement and Consent Order" (HFFACO) (Ecology et al. 1989)

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[2] *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*, 42 USC 9601, et seq.
[3] Public Law 99-499, 1986, "Superfund Amendments and Reauthorization Act of 1986 (SARA)," 100 Stat. 1728.
[4] *Resource Conservation and Recovery Act of 1976*, 42 USC 6901, et seq.
[5] EPA/ROD/R10-00/121, 2000, *Record of Decision for the USDOE Hanford 100 Area Burial Grounds (100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-2, 100-HR-2, and 100-KR-2 Operable Units*), U.S. Environmental Protection Agency, Region 10, Seattle, Washington
[6] EPA/ROD/R10-01/119, 2001, *Record of Decision for the USDOE Hanford 300 Area, 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. Amended in 2013: *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1*, U.S. Environmental Protection Agency and U.S. Department of Energy, Richland, Washington, Richland, Washington.
Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0087180.
[7] DOE/EIS-0222-F, 1999, Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement, U.S. Department of Energy, Washington, D.C.

JUSTIFICATION

Although the time period (100 years) for calculating the inadvertent intruder dose is specified in (DOE G 435.1-1), the actual facility closure year (i.e. start of institutional controls) is often not known with any certainty. The facility closure year is either based on "Hanford Federal Facility Agreement and Consent Order" (HFFACO) (Ecology et al. 1989) milestone or the most recent work schedule. For example, in *Performance Assessment of Waste Management Area C, Hanford Site, Washington* (RPP-ENV-58782), the facility closure year assumed in the initial version of the PA was 2020 which was approximate date for closure given in HFFACO Appendix D Milestone M-045-83 (Closure to occur by 06/30/2019) as it was defined in HFFACO Change M-45-09-01 (10/5/2010). That milestone date was not met and in August 2016, that HFFACO Appendix D Milestone M-045-83 was changed "Date Established in Milestone M-045-82 Tier 2 Closure Plan" HFFACO Change M-45-16-01 Rev. 1 (08/9/2016). Other planning documents also have the closure date changing. Additionally, the presence of the nearby double-shell tanks, and WMA A/AX may preclude putting the final cover over WMA C until those sites are also ready for closure (Figure 1).

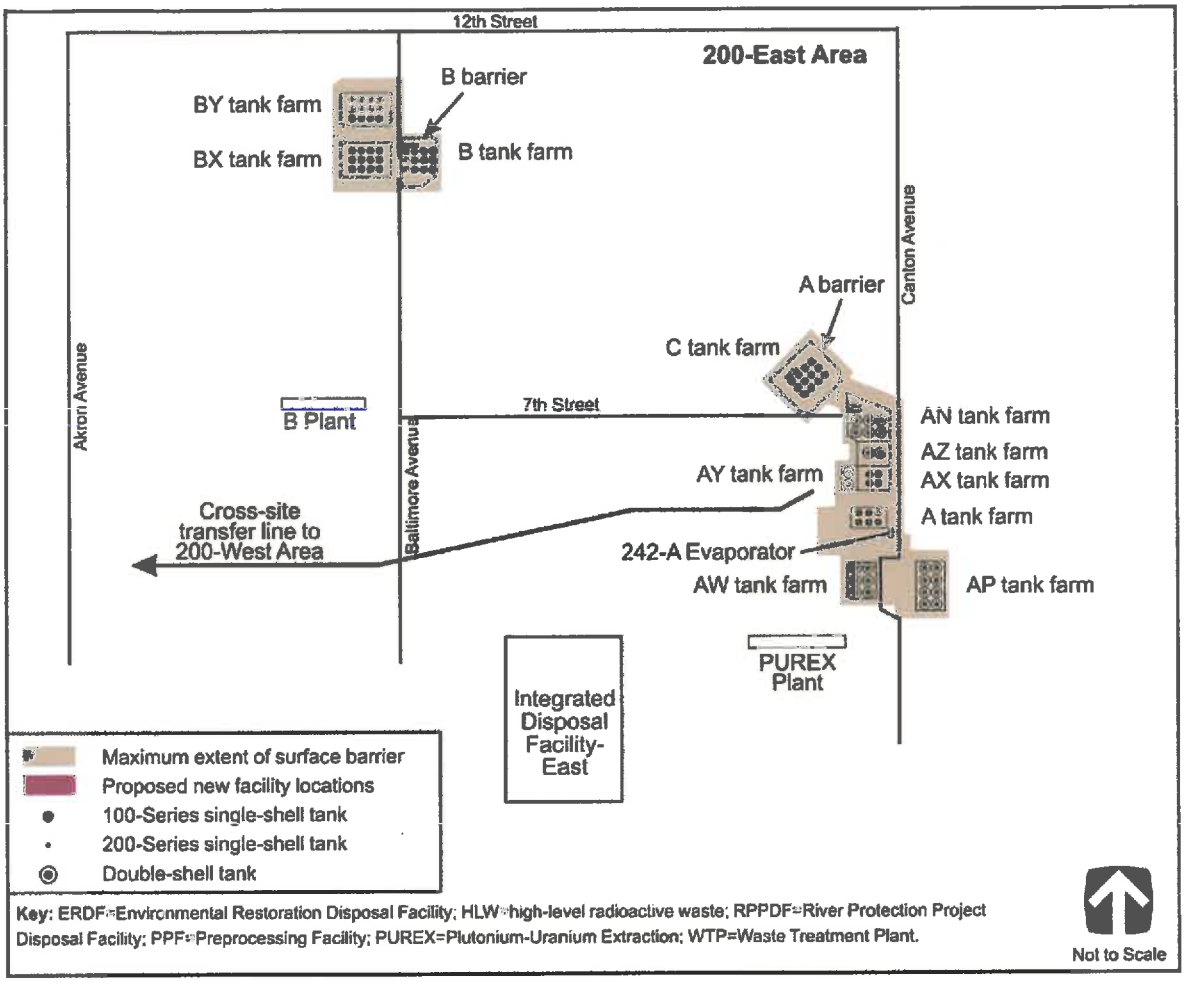
There are also a number of other low-level waste disposal facilities (other single-shell tank WMAs, double-shell tanks, Environmental Restoration Disposal Facility [ERDF], Integrated Disposal Facility [IDF]...) requiring a PA that are scheduled to be closed during the cleanup process. Table 1 provides a sample of how assumed closure year for a number of low-level waste disposal facilities have changed over time.

Table 1. Changes in Closure Year over Time for Hanford's Low-Level Waste Disposal Facilities

Facility	Closure Year	Document	Document Date
WMA C	6/30/2019	M-045-83 HFFACO Appendix D Change # M-45-09-01	10/05/2010
	Date Established in M-045-82 Tier 2 Closure Plan	M-045-83 HFFACO Appendix D Change # M-45-16-01 Rev 1	8/9/2016
	11/9/2018	ORP-11242 System Plan Rev 6. Baseline Case Table ES-1	8/24/2011
	6/2028	ORP-11242 System Plan Rev 8. Baseline Case Table ES-3	10/31/2017
	FY2068	Closure of Nearby DSTs RPP-RPT-60192 "System Plan, Revision 8, Lifecycle Cost Analysis" Baseline Case Table 5	1/18/2018
Complete Closure of SST System	9/30/2024	M-045-00 HFFACO Appendix D Change # M-45-93-01	01/25/1994
	1/31/2043	M-045-00 HFFACO Appendix D Change # M-45-09-01	10/05/2010
	10/5/2043	ORP-11242 System Plan Rev 6. Baseline Case Table ES-1	8/24/2011
	FY2061	RPP-RPT-60192 System Plan, Revision 8, Lifecycle Cost Analysis Baseline Case Table 5	1/18/2018
	FY2068	Closure of Nearby DSTs RPP-RPT-60192 "System Plan, Revision 8, Lifecycle Cost Analysis" Baseline Case Table 5	1/18/2018

Facility	Closure Year	Document	Document Date
Complete Closure of DST System	No Later than 9/30/2052	M-042-00A HFFACO Appendix D Change # M-42-09-01	10/05/2010
	03/18/2048	ORP-11242 "System Plan Rev 6". Baseline Case Table ES-1	8/24/2011
	11/2062	ORP-11242 "System Plan Rev 8". Baseline Case Table ES-3	10/31/2017
	FY2068	RPP-RPT-60192 "System Plan, Revision 8, Lifecycle Cost Analysis" Baseline Case Table 5	1/18/2018
Environmental Restoration Disposal Facility (ERDF)	5/2057	DOE/RL-2012-33 "Central Plateau Remediation Optimization Study" Table 2-6	9/19/2012
	2035	WCH-520 Rev. 1 "Performance Assessment for the Environmental Restoration Disposal Facility, Hanford Site, Washington", Section 1.3 Low Level Waste Disposal Facility Life Cycle	8/27/2013
Integrated Disposal Facility (IDF)	2050	RPP-CALC-61254 Rev. 02 "Inadvertent Intruder Dose Calculation Update for the Integrated Disposal Facility Performance Assessment" page 1-1	4/26/2018
	2068 (End of Operations)	ORP-11242 "System Plan Rev 8". Baseline Case Figure B-1	10/31/2017

Figure 1. Conceptualized Closure Surface Barriers for 200 East Area.



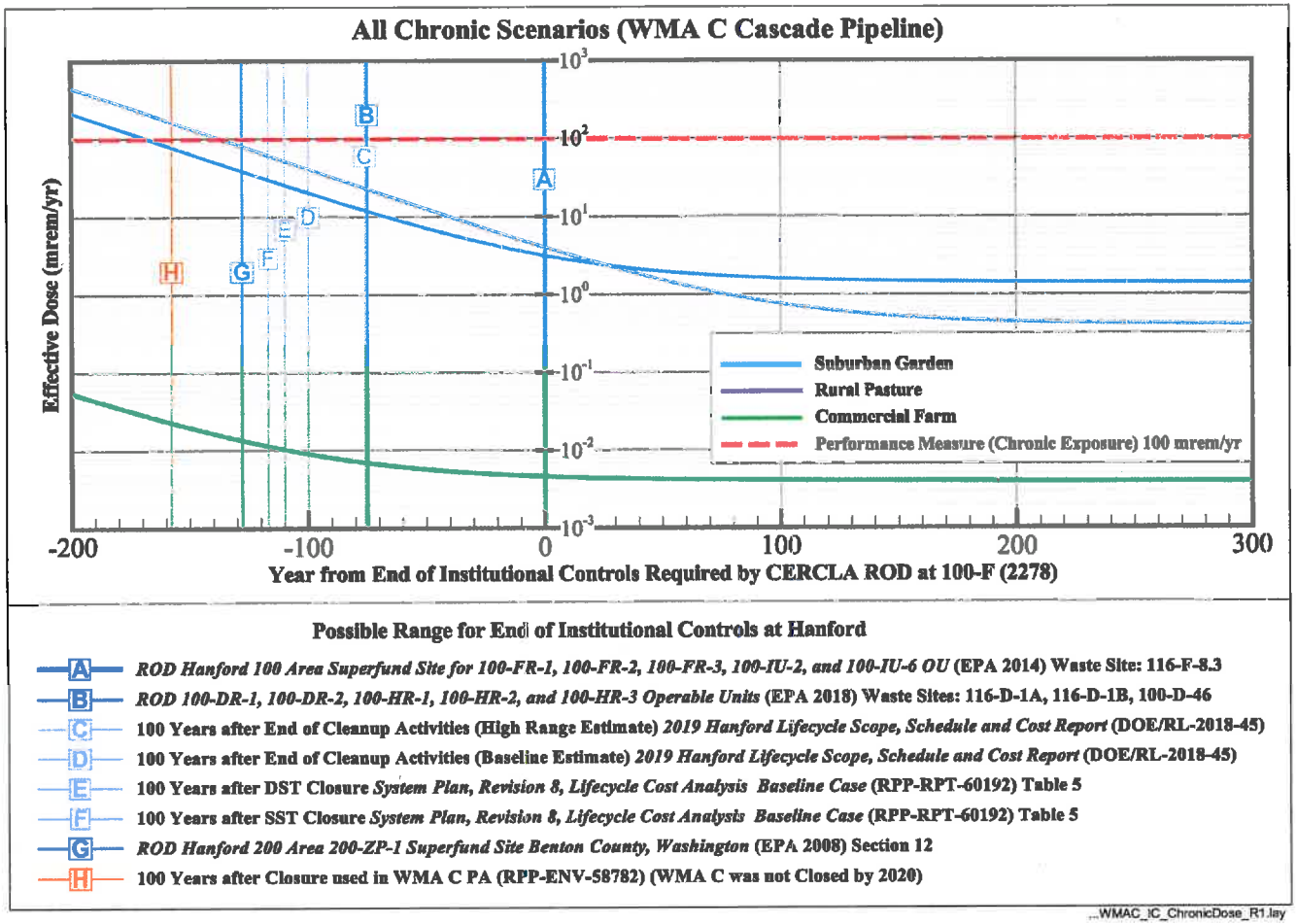
Source: DOE/EIS-0391, *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, Appendix E, Figure E-31.

The changes in the scheduled closure date of low-level waste facility can and do impact the calculated dose from inadvertent intrusion. A case in point is the chronic intruder dose from inadvertent intrusion into a fully plugged pipeline at WMA C as shown in Figure 2. The data depicting dose is the same as that used in Figure 9-15 of *Performance Assessment of Waste Management Area C, Hanford Site, Washington* (RPP-ENV-78782). Additionally, a number of lines have been added to Figure 2 that show the end of assumed ICs at various times.

The end of ICs used in WMA C performance assessment (100 years after the assumed scheduled closure in 2020) is shown as an orange line, those lines that show end of ICs as a Record of Decision are shown as dark blue lines, while those that show 100 years after the closure of the SSTs, DSTs, or end of clean-up activities are shown as light blue lines.

The calculated intruder for the rural pasture scenario for the assumed closure year in the WMA C performance assessment is approximately 160 mrem/year performance measure, slightly over the performance measure of 100 mrem/yr (Line H of Figure 2). The majority of that dose is due to exposure to ^{90}Sr and ^{137}Cs both of which have a half-life of approximately 30 years. If the end of ICs for the 200-ZP-1 ROD (EPA 2008) is used, the dose is reduced by ~50%, if the ROD (EPA 2018) for the waste sites 116-D-1A, 116-D-1B, and 100-D is used, the dose reduction is ~85%, and if the ROD (EPA 2014) for the end of ICs for the 116-F-8:3 waste site is used, the dose reduction is 97.5 %.

Figure 2. Effective Dose for All Chronic Exposure Scenarios for the Sensitivity Case of a Fully Plugged Cascade Pipeline



Source: Data on Dose from Figure 9-15 RPP-ENV-58782, *Performance Assessment of Waste Management Area C, Hanford Site, Washington*.

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J. Comments

Information Clearance Approval

APPROVED
By Janis D. Aardal at 9:10 am, May 05, 2020

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