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Semi-Annual Report on Strategic Special Nuclear Material Inventory Differences

July 1979

U.S. Department of Energy

Assistant Secretary for Defense Programs

Office of Safeguards and Security

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Available from:

National Technical Information Service (NTIS)
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Price:	Printed Copy:	\$ 4.50
	Microfiche:	\$ 3.00

STATEMENT OF THE
DEPARTMENT OF ENERGY (DOE) DIRECTOR OF SAFEGUARDS AND SECURITY

The Department of Energy has specified accounting requirements as part of its integrated safeguards system for the protection of special nuclear materials. This report provides and explains the generally small differences between the amounts of nuclear materials charged to DOE facilities and the amounts that could be physically inventoried.

These Inventory Differences, previously called Material Unaccounted For (MUF), are being publicly released on a semiannual basis. This report covers data for the period from April 1, 1978, through September 30, 1978, and includes accounting corrections for data from earlier periods. It is the fourth such semiannual report, subsequent to the August 4, 1977, publication (by DOE's predecessor, Energy Research and Development Administration) of all historical Inventory Difference data prior to October 1, 1976. All Inventory Differences reported here have been analyzed, investigated when necessary, and resolved.

These data and explanations, together with the absences of physical indications of any theft attempt, support a finding that during this period no theft or diversion of a significant amount of strategic special nuclear material has occurred.

George Weisz
Director
Office of Safeguards and Security
Department of Energy

UNITED STATES DEPARTMENT OF ENERGY
REPORT ON STRATEGIC SPECIAL NUCLEAR MATERIAL INVENTORY DIFFERENCES
APRIL 1, 1978 THROUGH SEPTEMBER 30, 1978

This fourth periodic semiannual report of Inventory Differences (ID) covers the last six months of fiscal year 1978 (April 1, 1978, through September 30, 1978), for the Department of Energy (DOE) and DOE contractor facilities possessing significant quantities of strategic special nuclear material (SSNM)*. The initial ID report, issued as ERDA 77-68 in August 1977, contained data for fiscal year 1976 (July 1, 1975, through September 30, 1976), for the Energy Research and Development Administration (ERDA) and ERDA contractor facilities and also contained historical data for ERDA/AEC and ERDA/AEC contractor facilities from 1947 through fiscal year 1975 and for AEC licensees from 1954 through calendar year 1967, including cumulative ID's by facility. The first semiannual ID report was issued as DOE/DP-000-1 in January 1978, and covered the first six months of fiscal year 1977. This report does not include data for the Rocky Flats and Y-12 nuclear weapons production facilities to protect classified weapons information..

Inventory Differences are the differences between the quantity of materials held in inventory according to the accounting records and the quantity measured by physical inventory. These differences are generally due to errors in estimating material in unmeasurable form at the time of an inventory, unmeasurable holdup in equipment, measurement imprecisions, inaccuracies in initial determinations of SSNM produced or used in nuclear reactors, and inventory or bookkeeping errors. However, since it is possible that even a small ID may be caused by theft of nuclear material, both DOE and contractors operating DOE facilities carefully maintain, analyze, and investigate ID data.

Differences between book and physical inventory values are expected in nuclear material processing and are not, in and of themselves, evidence of lost or stolen material. On the other hand, ID analysis provides valuable information on the effectiveness of the safeguards system's physical protection and material control measures as well as a check on the process controls and material management procedures. ID's outside safeguards control limits or involving a missing SSNM discrete item are investigated. If necessary, an operation may be shut down until an ID is resolved.

Analysis of accounting statistics alone, however, cannot show with absolute certainty that theft has not occurred. Therefore, DOE relies on a safeguards system that integrates stringent physical security

*Strategic special nuclear material is plutonium or uranium-233 or uranium-235 in material whose uranium-235 content is 20% or greater (known as highly enriched uranium). A significant quantity is either 2 kilograms of plutonium or uranium-233 or 5 kilograms of uranium-235 in highly enriched uranium or the appropriate weighted combination.

and material control measures with material measurement and accounting to ensure that material is not misappropriated. It is this total integrated safeguards system coupled with analysis and, when necessary, investigations of ID's, that DOE and DOE contractors operating DOE facilities use to arrive at a judgment of whether theft of significant amounts of SSNM has occurred.

Analyses of the data as they were generated, in each case, have resulted in the explanations for the ID's provided in this report. These explanations, together with the absence of physical indications of any theft attempt, support a finding that during this period no theft or diversion of a significant amount of nuclear material has occurred.

The Inventory Differences exhibited during this period are considered well within the calculated statistical variability of analytical measurements. They represent the summation of both apparent numerical gains and losses, subjected to enhancement according to the high volume of material processed or maintained on inventory. The explanations for the ID's in the report Columns headed "Analysis Findings" are consistent with previous reports. The analysis of the results of the more significant ID's contained in this report are discussed below.

The indicated 10.4 kilograms inventory increase in the plutonium account at the Los Alamos Scientific Laboratory resulted from cumulative differences due to decommissioning and cleanout activities of the plutonium processing lines.

The indicated 4.7 kilograms inventory increase in the plutonium account at the E. I. duPont de Nemours facility resulted from cumulative differences due to: (1) adjustments for shipper/receiver differences; (2) remeasurement of material; and (3) many small measurement inaccuracies.

The indicated 13.8 kilograms inventory decrease in the highly enriched uranium account at the Los Alamos Scientific Laboratory resulted from cumulative inventory differences due to more precise remeasurement of uranium scrap residue tailings generated and estimated in 1972 during recovery of uranium from ROVER Program uranium oxide fuels.

The indicated 41.8 kilograms inventory increase in the enriched uranium account at the E. I. duPont de Nemours facility resulted from cumulative inventory differences due to measurement uncertainties in fuel fabrication and resulting scrap material and shipper/receiver differences.

The ID's of the very low enriched uranium processed through the gaseous diffusion facilities at Portsmouth, Paducah, and Oak Ridge, involve the measurement of materials largely in gas-tight process equipment in a reactive gaseous form under elevated temperature and pressure. The ID's for this period are reasonable and consistent with expected normal operations and the very large amounts of materials handled in these types of facilities.

INVENTORY DIFFERENCE DATA
APRIL 1, 1978 TO SEPTEMBER 30, 1978

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
DOE AND DOE CONTRACTOR SPECIAL NUCLEAR MATERIALS
PLUTONIUM*

<u>Field Office and Contractor</u>	<u>Inventory Difference in Kilograms</u>	<u>Analysis Findings</u>
<u>Albuquerque</u>		
Los Alamos Scientific Laboratory Los Alamos, New Mexico	(10.4)	Cumulative inventory differences due to decommissioning and cleanout activities of the plutonium processing lines.
Mason & Hanger-Silas Mason Co., Inc., Amarillo, Texas	None	All parts contained in weapons have been accounted for.
Monsanto Research Corporation Mound Facility Miamisburg, Ohio	<0.1	Cumulative inventory differences due to measurement uncertainties for low-level residues.
Sandia Laboratories Albuquerque, New Mexico	None	All items contained in discrete identifiable forms have been accounted for.
<u>Chicago</u>		
Argonne National Laboratory Argonne, Illinois	<0.1	Cumulative inventory differences due to recording and reporting errors, rounding, and remeasurement of discrete material in inventory.

<0.1 means inventory difference amount is less than 50 grams.

() means an inventory increase.

* This and subsequent Plutonium tables exclude Pu-238 which is reported separately.

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
DOE AND DOE CONTRACTOR SPECIAL NUCLEAR MATERIALS
PLUTONIUM*

<u>Field Office and Contractor</u>	<u>Inventory Differences in Kilograms</u>	<u>Analysis Findings</u>
<u>Chicago (continued)</u>		
Argonne National Laboratory Idaho National Engineering Laboratory Idaho Falls, Idaho	<0.1	Cumulative inventory differences due to recording and reporting errors and rounding.
Battelle, Columbus Laboratories Columbus, Ohio	(<0.1)	Cumulative inventory differences due to rounding and remeasurement adjustments.
Brookhaven National Laboratory Upton, New York	None	Material contained in standards and sources. All items have been accounted for.
<u>Idaho</u>		
Allied Chemical Corporation CPP Idaho National Engineering Laboratory Idaho Falls, Idaho	None	All material accounted for.
EG&G Idaho, Inc. TRA Idaho National Engineering Laboratory Idaho Falls, Idaho	None	All material accounted for.

<0.1 means inventory difference amount is less than 50 grams.

() means an inventory increase.

*This and subsequent Plutonium tables exclude Pu-238 which is reported separately.

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
DOE AND DOE CONTRACTOR SPECIAL NUCLEAR MATERIALS
PLUTONIUM*

<u>Field Office and Contractor</u>	<u>Inventory Difference in Kilograms</u>	<u>Analysis Findings</u>
<u>Idaho (continued)</u>		
EG&G Idaho, Inc. ARA, LOFT, PBF, TAN Idaho National Engineering Laboratory Idaho Falls, Idaho	(0.1)	Cumulative inventory differences due to rounding.
<u>Nevada</u>		
Nevada Test Site Mercury, Nevada	None	All material contained in test devices has been accounted for.
<u>Oak Ridge</u>		
Oak Ridge National Laboratory Oak Ridge, Tennessee	<0.1	Cumulative inventory difference due to small measurement inaccuracies.
<u>Pittsburgh Naval Reactors</u>		
Duquesne Light Company Shippingport, Pennsylvania	None	Contained in irradiated fuel elements. All elements accounted for.

<0.1 means inventory difference amount is less than 50 grams.

() means an inventory increase.

*This and subsequent Plutonium tables exclude Pu-238 which is reported separately.

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
DOE AND DOE CONTRACTOR SPECIAL NUCLEAR MATERIALS
PLUTONIUM*

<u>Field Office and Contractor</u>	<u>Inventory Difference in Kilograms</u>	<u>Analysis Findings</u>
<u>Pittsburgh Naval Reactors (continued)</u>		
Westinghouse, Naval Reactors Facility Idaho National Engineering Laboratory Idaho Falls, Idaho	None	Contained in irradiated fuel elements. All elements accounted for.
Westinghouse, Bettis Atomic Power Laboratory West Mifflin, Pennsylvania	None	Contained in irradiated samples, standards and sources. All items accounted for.
<u>Richland</u>		
Rockwell Hanford Operations Richland, Washington	1.1	Cumulative inventory differences resulting from the combination of (1) material recovered from low-level waste repository; (2) remeasurement of material holdup in hoods and gloveboxes; and (3) other measure- ment uncertainties.
Hanford Engineering Development Laboratory Richland, Washington	0.2	Cumulative small inventory differences between measured values of plutonium taken at different inventory periods.
Battelle Pacific Northwest Laboratories Richland, Washington	(1.0)	Cumulative small inventory differences between measured values of plutonium taken at different inventory periods.

() means an inventory increase.

*This and subsequent Plutonium tables exclude Pu-238 which is reported separately.

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
DOE AND DOE CONTRACTOR SPECIAL NUCLEAR MATERIALS
PLUTONIUM

<u>Field Office and Contractor</u>	<u>Inventory Difference in Kilograms</u>	<u>Analysis Findings</u>
<u>Richland (continued)</u>		
United Nuclear Industries, Inc. Richland, Washington	(0.2)	Cumulative small inventory differences from periodic inventory evaluations of plutonium contained in irradiated fuel elements.
<u>San Francisco</u>		
Atomics International Canoga Park, California	(<0.1)	Cumulative inventory differences resulting from measurement uncertainty and rounding.
Lawrence Livermore Laboratory Livermore, California	0.8	Cumulative inventory differences resulting from determination of material in process, process holdup and rounding.
<u>Savannah River</u>		
E. I. duPont de Nemours Aiken, South Carolina	(4.7)	Cumulative differences resulting from the combination of (1) adjustment for shipper/receiver differences; (2) re-measurement of material; (3) many small measurement inaccuracies.

() means an inventory increase.
<0.1 means inventory difference amount is less than 50 grams.

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
DOE AND DOE CONTRACTOR SPECIAL NUCLEAR MATERIALS
U-235 IN 20% AND GREATER ENRICHED URANIUM

<u>Field Office and Contractor</u>	<u>Inventory Difference in Kilograms</u>	<u>Analysis Findings</u>
<u>Albuquerque</u>		
Los Alamos Scientific Laboratory Los Alamos, New Mexico	13.8	Cumulative inventory differences due to remeasurement of uranium fuel element scrap.
Mason & Hanger-Silas Mason Co., Inc. Amarillo, Texas	None	Contained in weapons parts. All parts accounted for.
Monsanto Research Corporation Mound Facility Miamisburg, Ohio	None	Contained in weapons parts. All parts accounted for.
Sandia Laboratories Albuquerque, New Mexico	0.1	Cumulative inventory differences due to rounding.
<u>Chicago</u>		
Argonne National Laboratory Argonne, Illinois	(<0.1)	Cumulative inventory differences due to recording and reporting errors and rounding.

() means an inventory increase.

<0.1 means inventory difference amount is less than 50 grams.

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
DOE AND DOE CONTRACTOR SPECIAL NUCLEAR MATERIALS
U-235 IN 20% AND GREATER ENRICHED URANIUM

<u>Field Office and Contractor</u>	<u>Inventory Difference in Kilegrams</u>	<u>Analysis Findings</u>
<u>Chicago (continued)</u>		
Argonne National Laboratory Idaho National Engineering Laboratory Idaho Falls, Idaho	1.8	Cumulative inventory differences due to recording and reporting errors, rounding, and shipper/receiver adjustments.
Battelle, Columbus Laboratories Columbus, Ohio	(0.2)	Cumulative inventory differences due to measurement adjustments and rounding.
Brookhaven National Laboratory Upton, New York	<0.1	Cumulative inventory differences due to rounding.
<u>Idaho</u>		
Allied Chemical Corporation CPP Idaho National Engineering Laboratory Idaho Falls, Idaho	<0.1	Difference due to remeasurement.
EG&G Idaho, Inc. TRA Idaho National Engineering Laboratory Idaho Falls, Idaho	(<0.1)	Cumulative inventory differences due to rounding and remeasurement.

<0.1 means inventory difference amount is less than 50 grams.

() means an inventory increase.

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
DOE AND DOE CONTRACTOR SPECIAL NUCLEAR MATERIALS
U-235 IN 20% AND GREATER ENRICHED URANIUM

<u>Field Office and Contractor</u>	<u>Inventory Difference in Kilograms</u>	<u>Analysis Findings</u>
<u>Idaho (continued)</u>		
EG&G Idaho, Inc. ARA, LOFT, PBF, TAN Idaho National Engineering Laboratory Idaho Falls, Idaho	None	All material accounted for.
<u>Nevada</u>		
Nevada Test Site Mercury, Nevada	None	Inventory consists principally of test devices and nuclear rocket fuel. All material accounted for.
<u>Oak Ridge</u>		
Goodyear Atomic Corporation Piketon, Ohio (except cascades)	2.9	Cumulative inventory differences due to remeasurement, sampling, and measure- ment uncertainties.
Oak Ridge National Laboratory Oak Ridge, Tennessee	(<0.1)	Cumulative inventory differences due to sampling and measurement uncertainties.

<0.1 means inventory difference amount is less than 50 grams.
() means an inventory increase.

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
DOE AND DOE CONTRACTOR SPECIAL NUCLEAR MATERIALS
U-235 IN 20% AND GREATER ENRICHED URANIUM

<u>Field Office and Contractor</u>	<u>Inventory Difference in Kilograms</u>	<u>Analysis Findings</u>
<u>Pittsburgh Naval Reactors (continued)</u>		
Pittsburgh Naval Reactors Office West Mifflin, Pennsylvania	None	Contained in unirradiated fuel elements. All elements accounted for.
Westinghouse, Bettis Atomic Power Laboratory West Mifflin, Pennsylvania	0.4	Cumulative inventory differences due to remeasurement of material in process and differences between estimated scrap value and measured material recovered.
Westinghouse, Naval Reactors Facility Idaho National Engineering Laboratory Idaho Falls, Idaho	None	Contained in unirradiated and irradiated fuel elements. All elements accounted for.
<u>Richland</u>		
Rockwell Hanford Operations Richland, Washington	None	Contained in scrap in static storage under seal. All material accounted for.
Hanford Engineering Development Laboratory Richland, Washington	1.0	Cumulative small inventory differences between measured values of enriched uranium taken at different inventory periods.

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
DOE AND DOE CONTRACTOR SPECIAL NUCLEAR MATERIALS
U-235 IN 20% AND GREATER ENRICHED URANIUM

<u>Field Office and Contractor</u>	<u>Inventory Difference in Kilograms</u>	<u>Analysis Findings</u>
<u>Richland (continued)</u>		
Battelle, Pacific Northwest Laboratories Richland, Washington	0.1	Cumulative small inventory differences between measured values of enriched uranium taken at different inventory periods.
<u>San Francisco</u>		
Atomics International Canoga Park, California	<0.1	Cumulative inventory differences resulting from measurement uncertainties and rounding.
Lawrence Livermore Laboratory Livermore, California	(0.5)	Cumulative inventory differences resulting from determination of material in process; process holdup differences, and rounding.
Lawrence Livermore Laboratory Mercury, Nevada	None	Contained in reactor fuel. All items accounted for.
<u>Savannah River</u>		
E. I. duPont de Nemours Aiken, South Carolina	(41.8)	Cumulative inventory differences resulting from measurement uncertainties in the processing and inventorying of scrap material from fuel fabrication, measurement uncertainties in the recovery process, and shipper/receiver adjustments.

<0.1 means inventory difference amount is less than 50 grams.
() means an inventory increase.

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
DOE AND DOE CONTRACTOR SPECIAL NUCLEAR MATERIALS
U-235 IN 20% AND GREATER ENRICHED URANIUM

<u>Field Office and Contractor</u>	<u>Inventory Difference in Kilograms</u>	<u>Analysis Findings</u>
<u>Schenectady Naval Reactors</u>		
General Electric Company Kesselring Site West Milton, New York	None	Inventory consists of prototype reactor fuel. All material accounted for.
General Electric Company Knolls Atomic Power Laboratory Schenectady, New York	(0.1)	Cumulative difference due to many small measurement differences and rounding.
General Electric Company Windsor Site, Windsor, Connecticut	None	Inventory consists of prototype reactor fuel. All material accounted for.

() means an inventory gain.

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
FOR THE URANIUM GASEOUS DIFFUSION PLANTS
ENRICHED URANIUM OF LESS THAN 5% U-235

<u>Field Office and Contractor</u>	<u>Inventory Difference in Kilograms</u>	<u>Analysis Findings</u>
<u>Oak Ridge</u>		
Goodyear Atomic Corporation Piketon, Ohio (Average Enrichment = 1.4%)	7.7	The inventory differences at all facilities are due to equipment holdup, the combined uncertainties of sampling and measurement of receipts, removals, gas phase inventory, and rounding of inventories to the nearest kilogram in the various material accountancy areas.
Union Carbide, Nuclear Division Oak Ridge, Tennessee (Average Enrichment = 1.00%)	15.8	
Union Carbide, Nuclear Division Paducah, Kentucky (Average Enrichment = 0.69%)	103.7	

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
DOE AND DOE CONTRACTOR SPECIAL NUCLEAR MATERIALS
URANIUM-233

<u>Field Office and Contractor</u>	<u>Inventory Difference in Kilograms</u>	<u>Analysis Findings</u>
<u>Albuquerque</u>		
Los Alamos Scientific Laboratory Los Alamos, New Mexico	None	No processing.
Monsanto Research Corporation Mound Facility Miamisburg, Ohio	None	No processing.
<u>Chicago</u>		
Argonne National Laboratory Argonne, Illinois	<0.1	Cumulative inventory differences due to rounding.
<u>Idaho</u>		
Allied Chemical Corporation CPP Idaho National Engineering Laboratory Idaho Falls, Idaho	None	Inventory consists principally of irradiated fuel elements. All elements accounted for.
<u>Oak Ridge</u>		
Oak Ridge National Laboratory Oak Ridge, Tennessee	<0.1	Cumulative inventory differences due to measurement uncertainties.

< 0.1 means inventory difference amount is less than 50 grams.

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
DOE AND DOE CONTRACTOR SPECIAL NUCLEAR MATERIALS
URANIUM-233

<u>Field Office and Contractor</u>	<u>Inventory Difference in Kilograms</u>	<u>Analysis Findings</u>
<u>Pittsburgh Naval Reactors</u>		
Duquesne Light Company Shippingport, Pennsylvania	None	Contained in irradiated fuel elements within an operating reactor. All elements accounted for.
Westinghouse, Bettis Atomic Power Laboratory West Mifflin, Pennsylvania	(1.0)	Cumulative inventory differences resulting from measurement of material after cleanup of the process line and removal of holdup.
<u>Richland</u>		
Rockwell Hanford Operations Richland, Washington	None	U-233 contained in large thorium holdings. No thorium inventory taken during the reporting period.
Battelle, Pacific Northwest Laboratories Richland, Washington	None	Contained in fabricated shapes in static storage under seal. All material accounted for.

() means an inventory increase.

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
DOE AND DOE CONTRACTOR SPECIAL NUCLEAR MATERIALS
URANIUM-233

<u>Field Office and Contractor</u>	<u>Inventory Difference in Kilograms</u>	<u>Analysis Findings</u>
<u>San Francisco</u>		
Lawrence Livermore Laboratory Livermore, California	<0.1	Cumulative inventory differences due to rounding.
<u>Savannah River</u>		
E. I. duPont de Nemours Aiken, South Carolina	None	Inventory consists principally of irradiated fuel in storage basin. All material accounted for.

<0.1 means inventory difference amount is less than 50 grams.

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
DOE AND DOE CONTRACTOR SPECIAL NUCLEAR MATERIALS
PLUTONIUM-238

<u>Field Office and Contractor</u>	<u>Inventory Difference in Kilograms</u>	<u>Analysis Findings</u>
<u>Albuquerque</u>		
Los Alamos Scientific Laboratory Los Alamos, New Mexico	(<0.1)	Cumulative inventory differences from cleanup of equipment and gloveboxes in process area.
Monsanto Research Corporation Mound Facility Miamisburg, Ohio	(<0.1)	Cumulative inventory differences from cleanup of equipment and gloveboxes in process area.
Sandia Laboratories Albuquerque, New Mexico	None	Material contained in heat sources. All sources accounted for.
<u>Oak Ridge</u>		
Oak Ridge National Laboratory Oak Ridge, Tennessee	<0.1	Cumulative inventory differences due to measurement uncertainties.

<0.1 means inventory difference amount is less than 50 grams.
() means an inventory increase.

SECOND HALF OF FISCAL YEAR 1978 INVENTORY DIFFERENCES
DOE AND DOE CONTRACTOR SPECIAL NUCLEAR MATERIALS
PLUTONIUM-238

<u>Field Office and Contractor</u>	<u>Inventory Difference in Kilograms</u>	<u>Analysis Findings</u>
<u>Richland</u>		
Rockwell Hanford Operations Richland, Washington	None	Contained in scrap in static storage under seal. All material accounted for.
<u>Savannah River</u>		
E. I. duPont de Nemours Aiken, South Carolina	(0.2)	Cumulative inventory differences due to remeasurements, shipper/ receiver adjustments and many small measurement inaccuracies.

() means an inventory increase.

ABBREVIATIONS

CPP Chemical Processing Plant
TRA Test Reactor Area
ARA Auxiliary Reactor Area
LOFT Loss of Fluid Test
PBF Power Burst Facility
TAN Test Area North