DOE/EIS-0283-S2
April 2015

Final

Surplus Plutonium Disposition Supplemental Environmental Impact Statement

Volume 1
(Chapters 1 through 10)

U.S. Department of Energy
Office of Material Management and Minimization
and
Office of Environmental Management
Washington, DC

AVAILABILITY OF THE
FINAL SURPLUS PLUTONIUM DISPOSITION
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
(*SPD Supplemental EIS*)

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Printed with soy ink on recycled paper

COVER SHEET[1]

Lead Agency: U.S. Department of Energy (DOE) / National Nuclear Security Administration (NNSA)

Cooperating Agency: Tennessee Valley Authority (TVA)

Title: *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement (SPD Supplemental EIS)* (DOE/EIS-0283-S2)

Locations: South Carolina, New Mexico, Alabama, and Tennessee

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Abstract: On March 28, 2007, DOE published a Notice of Intent (NOI) in the *Federal Register* (72 FR 14543) to prepare the *SPD Supplemental EIS* to evaluate the potential environmental impacts at the Savannah River Site (SRS) in South Carolina of disposition pathways for surplus weapons-usable plutonium (referred to as "surplus plutonium") originally planned for immobilization. The proposed actions and alternatives included construction and operation of a new vitrification capability in K-Area, processing in H-Canyon/HB-Line and the Defense Waste Processing Facility (DWPF), and fabricating mixed oxide (MOX) fuel in the MOX Fuel Fabrication Facility (MFFF) currently under construction in F-Area. Before the *Draft SPD Supplemental EIS* was issued, DOE decided to modify the scope of this *SPD Supplemental EIS* and evaluate additional alternatives. Therefore, on July 19, 2010, and again on January 12, 2012, DOE issued amended NOIs (75 FR 41850 and 77 FR 1920) announcing its intent to modify the scope of this *SPD Supplemental EIS*.

In this *SPD Supplemental EIS*, DOE describes the environmental impacts of alternatives for disposition of 13.1 metric tons (14.4 tons) of surplus plutonium for which a disposition path is not assigned, including 7.1 metric tons (7.8 tons) of plutonium from pits that were declared excess to national defense needs after publication of the 2007 NOI, and 6 metric tons (6.6 tons) of surplus non-pit plutonium. The analyses also encompass potential use of MOX fuel in reactors at the Sequoyah and Browns Ferry Nuclear Plants of TVA, and at generic reactors.

In this *SPD Supplemental EIS*, DOE evaluates the No Action Alternative and four action alternatives for disposition of 13.1 metric tons (14.4 tons) of surplus plutonium: (1) Immobilization to DWPF Alternative –

[1] *Vertical change bars in the margins of this Final Summary indicate revisions and new information added since the Draft Summary was issued in July 2012. Editorial changes are not marked.*

glass can-in-canister immobilization for both surplus non-pit and disassembled and converted pit plutonium and subsequent filling of the canister with high-level radioactive waste (HLW) at DWPF; (2) MOX Fuel Alternative – fabrication of the disassembled and converted pit plutonium and much of the non-pit plutonium into MOX fuel at MFFF for use in domestic commercial nuclear power reactors to generate electricity, as well as potential disposition of the surplus non-pit plutonium that is not suitable for MFFF as contact-handled transuranic (CH-TRU) waste at the Waste Isolation Pilot Plant (WIPP); (3) H-Canyon/HB-Line to DWPF Alternative – processing the surplus non-pit plutonium in H-Canyon/HB-Line and subsequent vitrification with HLW (in DWPF) and fabrication of the pit plutonium into MOX fuel at MFFF; and (4) WIPP Alternative – preparing for potential disposal as CH-TRU waste at WIPP the surplus non-pit and disassembled and converted pit plutonium in H-Canyon/HB-Line and the K-Area Complex at SRS, or preparing the surplus non-pit plutonium in H-Canyon/HB-Line and the K-Area Complex at SRS and preparing the surplus disassembled and converted pit plutonium in Technical Area 55 (TA-55) facilities at Los Alamos National Laboratory (LANL). Under all alternatives, DOE would also disposition as MOX fuel 34 metric tons (37.5 tons) of surplus plutonium in accordance with previous decisions. The 34 metric tons (37.5 tons) of plutonium would be fabricated into MOX fuel at MFFF for use at domestic commercial nuclear power reactors. Within each action alternative, DOE also evaluates options for pit disassembly and conversion of plutonium metal to an oxide form for disposition. Under three of the options, DOE would not build a stand-alone Pit Disassembly and Conversion Facility at F-Area at SRS, which DOE had previously decided to construct (65 FR 1608).

Preferred Alternative: DOE has no Preferred Alternative at this time for the disposition of the 13.1 metric tons (14.4 tons) of surplus plutonium that is the subject of this *SPD Supplemental EIS*. Also, DOE has no Preferred Alternative regarding the sites or facilities to be used to prepare surplus plutonium metal for disposition (i.e., pit disassembly and conversion capability). Consistent with the requirements of NEPA, once a Preferred Alternative is identified, DOE will announce its preference in a *Federal Register* notice. DOE would publish a Record of Decision no sooner than 30 days after its announcement of a preference.

This *SPD Supplemental EIS* evaluates disposition alternatives that include irradiation of MOX fuel in TVA reactors, subject to appropriate amendments to the applicable licenses from the U.S. Nuclear Regulatory Commission. TVA is a cooperating agency for this *SPD Supplemental EIS* and, as such, is not required to declare a preferred alternative. TVA does not have a preferred alternative at this time regarding whether to pursue irradiation of MOX fuel in TVA reactors and which reactors might be used for this purpose.

Public Comments: In preparing this *Final SPD Supplemental EIS*, DOE considered comments received during the three scoping periods (2007, 2010, 2012), during the public comment period on the *Draft SPD Supplemental EIS* (July 27 through October 10, 2012), and late comments received after the close of the public comment period. Public hearings on the *Draft SPD Supplemental EIS* were held in Tanner, Alabama; Chattanooga, Tennessee; North Augusta, South Carolina; and Carlsbad, Española, Los Alamos, and Santa Fe, New Mexico. DOE considered every comment received at the public hearings and by U.S. mail, email, and toll-free phone and fax lines during preparation of this *Final SPD Supplemental EIS*.

This *Final SPD Supplemental EIS* contains revisions and new information based in part on comments received on the *Draft SPD Supplemental EIS*. Volume 3 contains the comments received on the *Draft SPD Supplemental EIS* and DOE's responses to the comments. DOE will use the analysis presented in this *SPD Supplemental EIS*, as well as other information, in preparing a Record of Decision regarding the Surplus Plutonium Disposition Program. Consistent with the requirements of NEPA, once a Preferred Alternative is identified, DOE will announce its preference in a *Federal Register* notice. DOE would publish a Record of Decision no sooner than 30 days after its announcement of a preference. TVA, as a cooperating agency, may adopt this *Final SPD Supplemental EIS* after independently reviewing the environmental impact statement and determining that its comments and suggestions have been satisfied.

Note: A Foreword was added to the *Final SPD Supplemental EIS*. The Foreword describes two ongoing activities that may affect the implementation of the proposed action in this *SPD Supplemental EIS*. These activities are: (1) DOE's reassessment of surplus plutonium disposition strategies; and (2) DOE's recovery effort at WIPP following two February 2014 incidents at the facility.

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FOREWORD

This *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement (SPD Supplemental EIS)* has been prepared to evaluate the potential environmental impacts from disposition of 13.1 metric tons (14.4 tons) of surplus plutonium for which a disposition pathway is not yet assigned. This *SPD Supplemental EIS* is being issued in parallel with two ongoing U.S. Department of Energy (DOE) activities that may affect the implementation of the proposed action in this *SPD Supplemental EIS*. These activities are: (1) DOE's reassessment of surplus plutonium disposition strategies; and (2) DOE's recovery effort at the DOE Waste Isolation Pilot Plant (WIPP) following two February 2014 incidents at the facility near Carlsbad, New Mexico. DOE issued the *Draft SPD Supplemental EIS* in July 2012; issuing the *Final SPD Supplemental EIS* at this time enables DOE to complete the evaluation of the environmental impacts of the disposition of the 13.1 metric tons (14.4 tons) of surplus plutonium while neither prejudging nor impacting a separate ongoing DOE analysis of potential plutonium disposition strategies (see below).

Evolution of DOE's National Environmental Policy Act Decisions for Surplus Plutonium Disposition. DOE has pursued a program for safe storage and disposition of surplus weapons-grade plutonium since the mid-1990s. In 1996, DOE issued the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement (Storage and Disposition PEIS)* (DOE 1996), which considered a comprehensive range of 37 programmatic alternatives and subalternatives for disposition of plutonium surplus to the Nation's defense needs. DOE decided to pursue a combination of disposition approaches, including fabrication of surplus plutonium into mixed oxide (MOX) fuel for irradiation in domestic commercial nuclear reactors (62 *Federal Register* [FR] 3014). Tiering from the *Storage and Disposition PEIS*, DOE issued the *Surplus Plutonium Disposition Environmental Impact Statement (SPD EIS)* in 1999 (DOE 1999). Subsequent to the analyses in the *SPD EIS* and other documents, DOE decided to disposition 34 metric tons (37.5 tons) of surplus plutonium by fabricating it into MOX fuel in a MOX Fuel Fabrication Facility (MFFF) to be constructed at the Savannah River Site (SRS), followed by use of the MOX fuel in domestic commercial nuclear power reactors. DOE also decided to construct and operate a stand-alone Pit Disassembly and Conversion Facility (PDCF) at SRS to prepare surplus plutonium for the MFFF (65 FR 1608 and 68 FR 20134). DOE began construction of MFFF in August 2007. In addition, the *Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated As No Longer Required for Defense Purposes and Related Cooperation* (PMDA) that entered into force in 2011 calls for the United States and the Russian Federation to each dispose of at least 34 metric tons (37.5 tons) of weapons-grade plutonium, by fabricating it into MOX fuel or any other method as may be agreed to by the Parties in writing.

The purpose of this *SPD Supplemental EIS* is to evaluate the environmental impacts from alternatives for safe and timely disposition of approximately 13.1 metric tons (14.4 tons) of surplus plutonium for which a disposition pathway is not yet assigned, not to reconsider DOE's previous decisions about pursuing the MOX fuel approach for 34 metric tons (37.5 tons) of weapons-grade plutonium. The alternatives addressed in this *SPD Supplemental EIS* for the 13.1 metric tons (14.4 tons) of surplus plutonium are the No Action Alternative and action alternatives that entail combinations of one or more of the following disposition technologies: glass can-in-canister immobilization and subsequent filling of the canister with high-level radioactive waste (HLW) at the Defense Waste Processing Facility (DWPF), fabrication into MOX fuel followed by irradiation in domestic commercial nuclear power reactors, combination with HLW and subsequent vitrification at DWPF, and preparation as contact-handled transuranic waste for potential disposal at WIPP. In this *SPD Supplemental EIS*, DOE also evaluates options for pit disassembly and conversion in addition to a new stand-alone PDCF.

Evaluation of Alternative Surplus Plutonium Disposition Strategies. In April 2014, DOE's Plutonium Disposition Working Group issued its report, *Analysis of Surplus Weapon-Grade Plutonium Disposition Options* (DOE 2014), which assesses options that could potentially provide a more cost-effective approach for disposition of surplus U.S. weapons-grade plutonium and provides the foundation for further analysis and independent validation. The primary options assessed were irradiation as MOX fuel in light water reactors (i.e., domestic commercial nuclear power reactors), irradiation in fast reactors, immobilization with HLW, downblending and disposal, and deep borehole disposal. Variations on the assessed options were also considered. For each option, the Working Group assessed costs; compliance with international agreements; the time required to disposition 34 metric tons (37.5 tons) of surplus plutonium; technical viability; and legal, regulatory, and other issues. Completion of this *Final SPD Supplemental EIS* is independent of DOE's ongoing assessment of potential plutonium disposition strategies identified by the Plutonium Disposition Working Group.

February 2014 Incidents at WIPP. DOE has suspended operations at WIPP following two events that occurred in February 2014. On February 5, an underground salt haul truck caught fire, leading to the evacuation of all underground workers. Several workers were treated for smoke inhalation, but no other injuries were sustained as a result of this incident. The fire was extinguished and the underground operations at WIPP were suspended. On February 14, the WIPP facility experienced a second event unrelated to the fire, when a continuous air monitor (CAM) within the mine alarmed, indicating the presence of airborne radioactive material.

DOE has suspended waste disposal operations at WIPP and has implemented a recovery plan comprising several steps and processes to be completed before WIPP returns to operations. Detailed information on the status of recovery activities can be found at http://www.wipp.energy.gov/wipprecovery/recovery.html. Pending the return of WIPP to operations, transuranic waste generated by DOE activities is being safely stored at DOE or commercial sites.

Potential Decisions Supported by this *SPD Supplemental EIS*. In light of the circumstances described above, DOE is not in a position to make decisions on the issues presented in this *SPD Supplemental EIS* in the short term. On the other hand, DOE wishes to be able to move forward as rapidly as possible once issues concerning the availability of WIPP and the future of the MFFF are clarified. By completing this *SPD Supplemental EIS*, DOE will be in the best position to take actions to remove surplus plutonium from the State of South Carolina, and to disposition 13.1 metric tons (14.4 tons) of weapon-usable plutonium. For example, after the path for resumption of operations at WIPP is clarified, it would be possible for DOE to issue a Record of Decision for potential disposal at WIPP of certain surplus plutonium currently at SRS because the environmental implications of taking this step have already been analyzed in this *SPD Supplemental EIS*.

DOE has no Preferred Alternative at this time. Consistent with the requirements of the National Environmental Policy Act (NEPA), once a Preferred Alternative is identified, DOE will announce its preference in a *Federal Register* notice. DOE would publish a Record of Decision no sooner than 30 days after its announcement of a Preferred Alternative.

References

DOE (U.S. Department of Energy), 1996, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, DC, December.

DOE (U.S. Department of Energy), 1999, *Surplus Plutonium Disposition Final Environmental Impact Statement*, DOE/EIS-0283, Office of Fissile Materials Disposition, Washington, DC, November.

DOE (U.S. Department of Energy), 2014, *Report of the Plutonium Disposition Working Group: Analysis of Surplus Weapon-Grade Plutonium Disposition Options*, Washington, DC, April.

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ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

AADT	annual average daily traffic
ACS	American Community Survey
ALARA	as low as reasonably achievable
ARIES	Advanced Recovery and Integrated Extraction System
ATSDR	Agency for Toxic Substances and Disease Registry
BFN	Browns Ferry Nuclear Plant
BJWSA	Beaufort-Jasper Water and Sewer Authority
BLM	U.S. Bureau of Land Management
BMP	best management practice
C&D	construction and demolition
CCO	criticality control overpack
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CH-TRU	contact-handled transuranic
CMR	chemistry and metallurgy research
CMRR	Chemistry and Metallurgy Research Replacement
CMRR-NF	Chemistry and Metallurgy Research Replacement Nuclear Facility
CRD	Comment Response Document
CSWTF	Central Sanitary Wastewater Treatment Facility
DARHT	Dual-Axis Radiographic Hydrodynamic Test
dBA	decibels A-weighted
D&D	decontamination and decommissioning
DD&D	decontamination, decommissioning, and demolition
DHS	U.S. Department of Homeland Security
DNFSB	Defense Nuclear Facilities Safety Board
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DSA	Documented Safety Analysis
DWPF	Defense Waste Processing Facility
EA	environmental assessment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FFTF	Fast Flux Test Facility
FGE	fissile gram equivalents
FR	*Federal Register*
FY	fiscal year
g	acceleration of gravity
GENII 2	GENII Environmental Dosimetry system, Version 2
GTCC	Greater-Than-Class C
GWSB	Glass Waste Storage Building
Hanford	Hanford Site

HC/HBL	H-Canyon/HB-Line
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HLW	high-level radioactive waste
HUC	Hydrologic Unit Code
HUFP	Hanford Unirradiated Fuel Package
IPCC	Intergovernmental Panel on Climate Change
ISLOCA	interfacing systems loss-of-coolant accident
ISO	International Organization for Standardization
KIS	K-Area Interim Surveillance capability
LAHDRA	Los Alamos Historical Document Retrieval and Assessment
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
LCF	latent cancer fatality
LEED	Leadership in Energy and Environmental Design
LEU	low-enriched uranium
LLW	low-level radioactive waste
LOCA	loss-of-coolant accident
LOS	level of service
MACCS2	Melcor Accident Consequence Code System-2
MDA	material disposal areas
MEI	maximally exposed individual
MFFF	Mixed Oxide Fuel Fabrication Facility
MLLW	mixed low-level radioactive waste
MOX	mixed oxide
MSA	Material Storage Area
MSGP	Multi-Sector General Permit
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutant
NMAC	*New Mexico Administrative Code*
NMED	New Mexico Environment Department
NMSA	New Mexico Statutes Annotated
NMWQCC	New Mexico Water Quality Control Commission
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
ODS	ozone-depleting substances
Pantex	Pantex Plant
PCB	polychlorinated biphenyl
PDC	Pit Disassembly and Conversion Project
PDCF	Pit Disassembly and Conversion Facility
PEIS	programmatic environmental impact statement
PF-4	Plutonium Facility
PGA	peak (horizontal) ground acceleration

PM_n	particulate matter less than or equal to *n* microns in aerodynamic diameter
PMDA	Plutonium Management and Disposition Agreement
POC	pipe overpack container
PSD	prevention of significant deterioration
RADTRAN	Radioactive Material Transportation Risk Assessment computer code
RCRA	Resource Conservation and Recovery Act
RDX	Research Department Explosive
RH-TRU	remote-handled transuranic
RIMS II	Regional Input-Output Modeling System
RISKIND	Risks and Consequences of Radioactive Material Transport computer code
RLUOB	Radiological Laboratory/Utility/Office Building
RLWTF	Radioactive Liquid Waste Treatment Facility
ROD	Record of Decision
ROI	region of influence
SCDHEC	South Carolina Department of Health and Environmental Control
SEIS	supplemental environmental impact statement
SERF	Sanitary Effluent Reclamation Facility
SHPO	State Historic Preservation Office
SPD	surplus plutonium disposition
SQN	Sequoyah Nuclear Plant
SRARP	Savannah River Archaeological Research Program
SR	State Route
SRS	Savannah River Site
STA	Secure Transportation Asset
SWPPP	Storm Water Pollution Prevention Plan
SWEIS	site-wide environmental impact statement
SWWS	Sanitary Wastewater Systems
TA	technical area
TRAGIS	Transportation Routing Analysis Geographic Information System computer code
TRU	transuranic waste
TRUPACT-II	Transuranic Package Transporter Model 2
TSS	Transportation Safeguards System
TVA	Tennessee Valley Authority
U.S.C.	United States Code
VRM	Visual Resource Management
WAC	waste acceptance criteria
WIPP	Waste Isolation Pilot Plant
WSB	Waste Solidification Building
Y-12	Y-12 National Security Complex
ZPPR	Zero Power Physics Reactor
°C	degrees Celsius
°F	degrees Fahrenheit

CONVERSIONS

METRIC TO ENGLISH			ENGLISH TO METRIC		
Multiply	**by**	**To get**	**Multiply**	**by**	**To get**
Area					
Square meters	10.764	Square feet	Square feet	0.092903	Square meters
Square kilometers	247.1	Acres	Acres	0.0040469	Square kilometers
Square kilometers	0.3861	Square miles	Square miles	2.59	Square kilometers
Hectares	2.471	Acres	Acres	0.40469	Hectares
Concentration					
Kilograms/square meter	0.16667	Tons/acre	Tons/acre	0.5999	Kilograms/square meter
Milligrams/liter	1 [a]	Parts/million	Parts/million	1 [a]	Milligrams/liter
Micrograms/liter	1 [a]	Parts/billion	Parts/billion	1 [a]	Micrograms/liter
Micrograms/cubic meter	1 [a]	Parts/trillion	Parts/trillion	1 [a]	Micrograms/cubic meter
Density					
Grams/cubic centimeter	62.428	Pounds/cubic feet	Pounds/cubic feet	0.016018	Grams/cubic centimeter
Grams/cubic meter	0.0000624	Pounds/cubic feet	Pounds/cubic feet	16,018.5	Grams/cubic meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Radiation					
Sieverts	100	Rem	Rem	0.01	Sieverts
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F - 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cubic meters/second	2118.9	Cubic feet/minute	Cubic feet/minute	0.00047195	Cubic meters/second
Grams/second	7.9366	Pounds/hour	Pounds/hour	0.126	Grams/second
Meters/second	2.237	Miles/hour	Miles/hour	0.44704	Meters/second
Volume					
Liters	0.26418	Gallons	Gallons	3.7854	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.314	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1233.49	Cubic meters
Weight/Mass					
Grams	0.035274	Ounces	Ounces	28.35	Grams
Kilograms	2.2046	Pounds	Pounds	0.45359	Kilograms
Kilograms	0.0011023	Tons (short)	Tons (short)	907.18	Kilograms
Metric tons	1.1023	Tons (short)	Tons (short)	0.90718	Metric tons
ENGLISH TO ENGLISH					
Acre-feet	325,850.7	Gallons	Gallons	0.000003046	Acre-feet
Acres	43,560	Square feet	Square feet	0.000022957	Acres
Square miles	640	Acres	Acres	0.0015625	Square miles

a. This conversion is only valid for concentrations of contaminants (or other materials) in water.

METRIC PREFIXES

Prefix	Symbol	Multiplication factor
exa-	E	1,000,000,000,000,000,000 = 10^{18}
peta-	P	1,000,000,000,000,000 = 10^{15}
tera-	T	1,000,000,000,000 = 10^{12}
giga-	G	1,000,000,000 = 10^{9}
mega-	M	1,000,000 = 10^{6}
kilo-	k	1,000 = 10^{3}
deca-	D	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	µ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}