DOE/EIS-0236-S4

National Nuclear Security Administration

# Final Complex Transformation Supplemental Programmatic Environmental Impact Statement

## Volume II
## Chapters 5 - 15 and Appendices A - G

COMPLEXtransformation

National Nuclear Security Administration
U.S. Department of Energy

October 2008

## COVER SHEET

**RESPONSIBLE AGENCY:** U.S. Department of Energy, National Nuclear Security Administration

**TITLE:** Final Complex Transformation Supplemental Programmatic Environmental Impact Statement (Complex Transformation SPEIS, DOE/EIS-0236-S4)

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**ABSTRACT:** The National Nuclear Security Administration (NNSA), an agency within the Department of Energy, has the responsibility to maintain the safety, security, and reliability of the United States' nuclear weapons stockpile. This Complex Transformation Supplemental Programmatic Environmental Impact Statement (SPEIS) analyzes the potential environmental impacts of reasonable alternatives to continue transformation of the nuclear weapons complex to be smaller, and more responsive, efficient, and secure in order to meet national security requirements. The current Complex consists of sites located in seven states (California, Missouri, Nevada, New Mexico, South Carolina, Tennessee, and Texas). This SPEIS evaluates alternatives that would restructure special nuclear materials manufacturing and research and development facilities; consolidate special nuclear materials throughout the Complex; consolidate, relocate, or eliminate duplicative facilities and programs and improve operating efficiencies; and identify one or more sites for conducting NNSA flight test operations.


**COOPERATING AGENCIES:** The Department of the Air Force and the U.S. Army Garrison White Sands are cooperating agencies in the preparation of this Complex Transformation SPEIS.

**PUBLIC COMMENTS:** The Draft Complex Transformation SPEIS was issued for public review and comment on January 11, 2008. Comments on the Draft SPEIS were requested during a period of 90 days following publication of the U.S. Environmental Protection Agency's (EPA's) Notice of Availability in the *Federal Register*. Twenty public hearings to solicit comments on the Draft SPEIS were held during the public comment period. Prior to the end of this comment period, NNSA extended the public comment period by 20 additional days, until April 30, 2008. All comments received during the comment period were considered during preparation of the Final SPEIS. Late comments were also considered, to the extent practicable.

The Final SPEIS contains revisions and new information based in part on comments received on the Draft SPEIS. Vertical change bars in the margins indicate the locations of these revisions and new information. Volume 3 contains the comments received during the public comment period on the Draft SPEIS and NNSA's responses to the comments. NNSA will use the analysis presented in this Final SPEIS, as well as other information, in preparing the Record(s) of Decision (RODs) regarding Complex Transformation. NNSA will issue one or more RODs no sooner than 30 days after the EPA publishes a Notice of Availability of this Final SPEIS in the *Federal Register*. This document and related information are available on the Internet at www.ComplexTransformationSPEIS.com.

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Prepared by:

National Nuclear Security Administration
U.S. Department of Energy

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| A/D | Assembly/Disassembly |
| A/D/HE | Assembly/Disassembly/High Explosives |
| AC and MC | Analytical Chemistry and Materials Characterization |
| ACE | Altamont Commuter Express |
| ACHP | Advisory Council on Historic Preservation |
| ACRR | Annular Core Research Reactor |
| AEC | Atomic Energy Commission |
| AFB | Air Force Base |
| AF&F | Arming, Fuzing, and Firing |
| ALARA | as low as reasonably achievable |
| ALCM | Air-Launch Cruise Missile |
| ALOHA | Aerial Location of Hazardous Atmospheres |
| AQCR | Air Quality Control Region |
| ARF | airborne release fraction |
| ASER | annual site environmental report |
| ATEC | U.S. Army Test Evaluation Command |
| BA | Biological Assessment |
| BAAQMD | Bay Area Air Quality Management District |
| BACMs | Best Available Control Measures |
| BEA | Bureau of Economic Analysis |
| BEEF | Big Explosives Experimental Facility |
| BEIR | Biological Effects of Ionizing Radiation |
| Bison-m | Biota Information System of New Mexico |
| BLM | Bureau of Land Management |
| BLS | Bureau of Labor Statistics |
| BMAP | Biological Monitoring and Abatement Program |
| BMPs | Best Management Practices |
| BNM | Bandelier National Monument |
| CA | Composite Analysis |
| CAA | *Clean Air Act* |
| CAIRS | Computerized Accident/Incident Reporting System |
| CAMU | corrective action management unit |
| CASSC | California Species of Special Concern |
| CAUs | Corrective Action Units |
| CD-0 | critical decision on mission need |
| CEQ | Council on Environmental Quality |
| CERCLA | *Comprehensive Environmental Response, Compensation, and Liability Act* |
| CFF | Contained Firing Facility |
| CFR | Code of Federal Regulations |
| CGTO | Consolidated Group of Tribes and Organizations |
| CHS | Center for Homeland Security |
| CIF | Consolidated Incineration Facility |
| CMR | Chemistry and Metallurgy Research |

| | |
|---|---|
| CMRR | Chemistry and Metallurgy Research Building Replacement Project |
| CNC | Consolidated Nuclear Center |
| CNPC | Consolidated Nuclear Production Center |
| CNPS | California Native Plant Society |
| Complex | nuclear weapons complex |
| Complex Transformation SPEIS | Complex Transformation Supplemental Programmatic Environmental Impact Statement |
| COPCs | contaminants of potential concern |
| CPC | Consolidated Plutonium Center |
| CRT | Cargo Restraint Transporter |
| CSAs | Canned Subassemblies |
| CUC | Consolidated Uranium Center |
| CWA | *Clean Water Act* |
| CWL | chemical waste landfill |
| CY | calendar year |
| D&D | Decontamination and Decommissioning |
| DA | design agency |
| DAF | Device Assembly Facility |
| DARHT | Dual Axis Radiographic Hydrodynamic Test |
| dB | decibel |
| dBA | A-weighted decibels |
| DAF | Device Assembly Facility |
| DCE | Distributed Centers of Excellence |
| DCGs | Derived Concentration Guidelines |
| DHHS | U.S. Department of Health and Human Services |
| DHS | U.S. Department of Homeland Security |
| DoD | U.S. Department of Defense |
| DOE | U.S. Department of Energy |
| DOI | U.S. Department of the Interior |
| DOT | U.S. Department of Transportation |
| DP | Defense Programs |
| DPE | data processing equipment |
| DR | damage ratio |
| DTC | Developmental Test Command |
| DTRA | Defense Threat Reduction Agency |
| DTSC | Department of Toxic Substances Control |
| DU | Depleted Uranium |
| DWPF | Defense Waste Processing Facility |
| DWTF | Decontamination and Waste Treatment Facility |
| DX | Dynamic Experimentation |
| EA | Environmental Assessment |
| ECF | Entry Control Facility |
| EDE | effective dose equivalent |
| EE | Energy Efficiency and Renewable Energy |
| EFPC | East Fork Poplar Creek |
| EH | Office of Environment, Safety and Health |

| | |
|---|---|
| EIS | Environmental Impact Statement |
| EM | Environmental Management |
| EMAC | Ecological Monitoring and Compliance Program |
| EOA | expanded operations alternative |
| EODU | Explosive Ordinance Disposal Unit |
| EOL | End-of-Life |
| EOS | Equation of state |
| EPA | U.S. Environmental Protection Agency |
| ER | Environmental Restoration |
| ERPG | Emergency Response Planning Guideline |
| ESL | Effects Screening Level |
| ETB | Engineering Test Bay |
| ETF | Environmental Test Facility |
| ETTP | East Tennessee Technology Park |
| EU | enriched uranium |
| EWTF | Explosives Waste Treatment Facility |
| FBI | Federal Bureau of Investigation |
| FE | facilities engineering |
| FGZ | fine-grain zone |
| FLAME | Fire Laboratory for Accreditation of Models and Experiments |
| FM | Farm-to-Market Road |
| FMD | Fissile Materials Disposition |
| FONSI | Finding of No Significant Impact |
| FPPA | *Farmland Protection Policy Act* |
| FTE | Full Time Employee |
| FWHM | Full Width at Half Maximum |
| FXR | Flash X-Ray |
| GCD | Greater Confinement Disposal |
| GIF | Gamma Irradiation Facility |
| GPD | gallons per day |
| GPS | Global Positioning System |
| GSA | General Services Area |
| GTS | Gas Transfer System |
| GWPP | groundwater protection program |
| HAN | hydroxylamine nitrate |
| HANDSS-55 | “handling and segregation system for 55-gallon drums” |
| HANMF | H-Area New Manufacturing Facility |
| HAPs | Hazardous Air Pollutant |
| HE | High Explosives |
| HEAF | High Explosives Application Facility |
| HEPA | high-efficiency particulate air |
| HETB | Hardened Engineering Test Building |
| HEU | Highly Enriched Uranium |
| HEUMF | Highly Enriched Uranium Materials Facility |
| HEWTF | High Explosives Wastewater Treatment Facility |
| HI | Hazard Index |

| | |
|---|---|
| HLW | high level radioactive waste |
| HPS | Hantavirus Pulmonary Syndrome |
| HQ | Hazard Quotient |
| HR | Human Resources |
| HSC | Hazardous Materials Spill Center |
| HTM | High-Tech Mobile |
| HVAC | heating, ventilating, and air conditioning |
| HWDU | Hazardous waste disposal units |
| HWMF | hazardous waste management facility |
| HWSU | Hazardous Waste Storage Unit |
| HWTPF | Hazardous Waste Treatment and Processing Facility |
| HYDEC | hydride/dehydride casting |
| I | Interstate Highway |
| ICD-9-CM | International Classification of Disease, 9th Revision, Clinical Modification |
| ICRP | International Commission on Radiological Protection |
| IFF | Identification, Friend or Foe |
| IH | Industrial Hygiene |
| INEEL | Idaho National Engineering and Environmental Laboratory |
| INRAD | intrinsic radiation |
| IOM | Institution of Medicine |
| IPT | Integrated Project Team |
| ISCORS | Interagency Steering Committee on Radiation Standards |
| ISCST | Industrial Source Complex Short Term |
| ISD | Independent School District |
| ISM | Integrated Safety Management |
| ISMS | Integrated Safety Management System |
| ITRD | Innovative Treatment Remediation Demonstration |
| IWQPs | Inland Water Quality Parameters |
| JTA | Joint Test Assemblies |
| KAFB | Kirtland Air Force Base |
| KCP | Kansas City Plant |
| KCRIMS | Kansas City Responsive Infrastructure Manufacturing and Sourcing |
| KTF | Kauai Test Facility |
| LAC | Los Alamos County |
| LANL | Los Alamos National Laboratory |
| LANL SWEIS | Site-Wide Environmental Impact Statement for the Continued Operation of the Los Alamos National Laboratory |
| LANSCE | Los Alamos Neutron Science Center |
| LB/TS | Large Blast Thermal Simulator |
| LCF | latent cancer fatality |
| LDRGIF | Low Dose Rate Gamma Irradiation Facility |
| LLNL | Lawrence Livermore National Laboratory |
| LLW | low level waste |
| LOS | Level of Service |

| | |
|---|---|
| LPF | leak path factor |
| M&O | Management and Operations |
| MACCS | MELCOR Accident Consequence Code System |
| MACCS2 | MELCOR Accident Consequence Code System Version 2 |
| MACs | maximum allowable concentrations |
| MAR | material at risk |
| MBTA | *Migratory Bird Treaty Act* |
| MC&A | Material Control and Accountability |
| MCL | maximum contaminant level |
| MDC | maximum detectable concentration |
| MDL | maximum detection limit |
| MEI | maximally exposed individual |
| MEK | methyl ethyl ketone |
| MLLW | mixed low level waste |
| MOX | Mixed Oxide |
| MPF | Modern Pit Facility |
| MPF EIS | Modern Pit Facility Environmental Impact Statement |
| mrem | millirem |
| MRTFB | Major Range and Test Facility Base |
| MSGP | Multi-Sector General Permit |
| MVAs | motor vehicle accidents |
| MVM | million vehicle miles |
| MWDU | Mixed Waste Disposal Unit |
| NAAQS | National Ambient Air Quality Standards |
| NAFB | Nellis Air Force Base |
| NC | numerically controlled |
| NCRP | National Council on Radiation Protection Measurements |
| NDA | nondestructive assay |
| NDEP | Nevada Division of Environmental Protection |
| NE | Office of Nuclear Energy |
| NECI | Northeast Center Impact Area |
| NEP | Nuclear Explosive Package |
| NEPA | *National Environmental Policy Act* |
| NESHAP | National Emission Standards for Hazardous Air Pollutants |
| NEST | Nuclear Emergency Search Team |
| NGPF | Neutron Generator Production |
| NHP | National Hydrotesting Program |
| NHPA | *National Historic Preservation Act* |
| NMAAQS | New Mexico Ambient Air Quality Standards |
| NMAQCR | New Mexico Air Quality Control Regulations |
| NMED | New Mexico Environment Department |
| NMWQCC | New Mexico Water Quality Control Commission |
| NN | Nonproliferation and National Security |
| NNSA | National Nuclear Security Administration |
| NOAA | National Oceanic and Atmospheric Administration |
| NOI | Notice of Intent |

| | |
|---|---|
| NPDES | National Pollutant Discharge Elimination System |
| NPL | National Priorities List |
| NPR | Nuclear Posture Review |
| NPS | National Park Service |
| NPT | Nuclear Nonproliferation Treaty |
| NPTEC | Nonproliferation Test and Evaluation Complex |
| NRCS | Natural Resources Conservation Service |
| NRHP | National Register of Historic Places |
| NSO | Nevada Site Office |
| NSTec | National Security Technologies |
| NTS | Nevada Test Site |
| NTTR | Nevada Test and Training Range |
| NWS | National Weather Service |
| NWSM | Nuclear Weapons Stockpile Memorandum |
| NWSP | Nuclear Weapons Stockpile Plan |
| OB/OD | Open Burn/Open Detonation |
| OEPG | Office of Environmental Policy and Guidance |
| ORNL | Oak Ridge National Laboratory |
| ORPS | Occurrence Reporting and Processing System |
| ORR | Oak Ridge Reservation |
| OSHA | Occupational Safety and Health Administration |
| OST | Office of Secure Transportation |
| OUs | operable units |
| PA | Performance Assessment |
| PAAA | *Price-Anderson Amendments Act* |
| Pantex | Pantex Plant |
| PCBs | polychlorinated biphenyls |
| pCi/L | picocuries per liter |
| PDCF | Pit Disassembly and Conversion Facility |
| PF-4 | Plutonium Facility, Building 4 |
| PHERMEX | Pulsed High Energy Radiation Machine Emitting X-Rays |
| PHETS | Permanent High Explosive Test Site |
| PIDAS | Perimeter Intrusion Detection and Assessment System |
| PIXY | Pulse Intense X-Ray |
| PMDA | Plutonium Management and Disposition Agreement |
| POLs | petroleum, oils, lubricants |
| PPE | personal protective equipment |
| ppy | pits per year |
| PQL | practical quantitation limit |
| PSD | Prevention of Significant Deterioration |
| PSRs | Potential release sites |
| Pu | Plutonium |
| PUREX | Plutonium-Uranium Extraction Process |
| QASPR | Qualification Alternatives to Sandia Pulsed Reactor |
| R&D | Research and Development |
| RANT | Radioassay and Nondestructive Testing |

| | |
|---|---|
| RCRA | *Resource Conservation and Recovery Act* |
| rem | roentgen equivalent man |
| REOP | Real Estate Operating Permit |
| RF | respirable fraction |
| RFI | RCRA facility investigation |
| RIMSII | Regional Input-Output Modeling System |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMWMF | Radioactive and Mixed Waste Management Facilities |
| ROD | Record of Decision |
| ROGs/POCs | reactive organic gases/precursor organic compounds |
| ROI | Region of Influence |
| RRF | respirable release fraction |
| RRW | Reliable Replacement Warhead |
| RWMC | Radioactive Waste Management Complex |
| RWMS | Radioactive Waste Management Site |
| S.C. | South Carolina State Highway |
| SAAQS | State Ambient Air Quality Standards |
| SASN | Silver acetylide-silver nitrate |
| SCDHEC | South Carolina Department of Health and Environmental Control |
| SEAB | Secretary of Energy Advisory Board |
| SEIS | Supplemental Environmental Impact Statement |
| SFNF | Santa Fe National Forest |
| SGT | Safeguards Transporters |
| SHIST | Seismic Hardrock in Site Test |
| SHPO | State Historic Preservation Office |
| SJVUAPCD | San Joaquin Valley Unified Air Pollution Control District |
| SMR | standardized mortality rate |
| SNF | Spent nuclear fuel |
| SNL | Sandia National Laboratories |
| SNL/NM | Sandia National Laboratories/New Mexico |
| SNL/CA | Sandia National Laboratories/California |
| SNM | Special nuclear material |
| SPEIS | Supplemental Programmatic Environmental Impact Statement |
| SRARP | Savannah River Archaeological Research Program |
| SREL | Savannah River Ecology Laboratory |
| SRS | Savannah River Site |
| SS&C | sand, slag and crucible |
| SSM | Stockpile Stewardship and Management |
| SSM PEIS | Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management |
| SSO | Sandia Site Office |
| SSP | Stockpile Stewardship Program |
| SST | Safe Secure Trailers |
| STP | Site Treatment Plan |
| STS | Stock-to-Target Sequence |
| SVOC | Semi-volatile organic compound |

| | |
|---|---|
| SWEIS | Site-Wide Environmental Impact Statement |
| SWSC | Sanitary Wastewater Systems Consolidation |
| SWTF | Solid Waste Transfer Facility |
| T&E | Threatened and Endangered |
| TA | Technical Area |
| TA-55 | Technical Area 55 |
| TBF | Terminal Ballistics Facility |
| TBP | tributyl phosphate |
| TCEQ | Texas Commission on Environmental Quality |
| TCP | Traditional Cultural Property |
| TECC | Transportation and Emergency Control Center |
| TEDE | Total Effective Dose Equivalent |
| TEF | Tritium Extraction Facility |
| TLD | Thermoluminescent dosimeter |
| TNRCC | Texas Natural Resource Conservation Commission |
| TPCB | Transurance Pad Cover Building |
| TPDES | Texas Pollutant Discharge Elimination System |
| TRAGIS | Transportation Routing Analysis Geographic Information System |
| Trinity NHL | Trinity Site National Historic Landmark |
| TRU | transuranic |
| TRUPACT-II | Transuranic Package Transporter |
| TSCA | Toxic Substance Control Act |
| TSD | Transportation Safequards Division |
| TSP | total suspended particulates |
| TSPI | Time Space Positioning Information |
| TTR | Tonopah Test Range |
| TVA | Tennessee Valley Authority |
| UC | University of California |
| UPF | Uranium Processing Facility |
| US | United States |
| USACE | United States Army Corps of Engineers |
| USAF | United States Air Force |
| USC | United States Code |
| USFS | United States Forest Service |
| USFWS | United States Fish and Wildlife Service |
| USGS | United States Geologic Survey |
| USPHS | United States Public Health Service |
| UXO | unexploded ordnance |
| VOC | volatile organic compound |
| VPP | Voluntary Protection Program |
| WAC | Waste Acceptance Criteria |
| WCRRF | Waste Compaction, Reduction, and Repackaging Facility |
| WEF | Waste Examination Facility |
| WETF | Weapons Engineering Tritium Facility |
| WFO | Work for Others |
| WIPP | Waste Isolation Pilot Plant |

| | |
|---|---|
| WSMR | White Sands Missile Range |
| WSRC | Washington Savannah River Company |
| WTG | Weapons Test Group |
| WVDP | West Valley Demonstration Project |
| WWTF | Wastewater Treatment Facility |
| XTF | Cross-wind Fire Facility |
| Y-12 | Y-12 National Security Complex |

# CHEMICALS AND UNITS OF MEASURE

| | |
|---|---|
| Bq | Becquerel |
| C | Celsius |
| Ci | curie |
| cm | centimeters |
| CFC | chlorofluorocarbons |
| CO | carbon monoxide |
| dB | decibel |
| dBA | decibel A-weighted |
| DCE | 1, 2-dichloroethylene |
| DNA | deoxyribonucleic acid |
| F | Fahrenheit |
| ft | feet |
| $ft^2$ | square feet |
| $ft^3$ | cubic feet |
| $ft^3/s$ | cubic feet per second |
| g | grams |
| gal | gallons |
| ha | hectares |
| hr | hour |
| in | inches |
| kg | kilograms |
| km | kilometers |
| $km^2$ | square kilometers |
| kV | kilovolts |
| kVA | kilovolt-ampere |
| kW | kilowatts |
| kWh | kilowatt hours |
| L | liters |
| lb | pounds |
| m | meters |
| $m^2$ | square meters |
| $m^3$ | cubic meters |
| m/s | meters per second |
| mg | milligram (one-thousandth of a gram) |
| mg/L | milligrams per liter |
| MGD | million gallons per day |

| | |
|---|---|
| MGY | million gallons per year |
| mi | miles |
| $mi^2$ | square miles |
| mph | miles per hour |
| mrem | millirem (one-thousandth of a rem) |
| MVA | megavolt-ampere |
| MW | megawatt |
| MWe | megawatt electric |
| MWh | megawatt hour |
| $NO_2$ | nitrogen dioxide |
| NOX | nitrogen oxides |
| $O_3$ | ozone |
| Pb | lead |
| PCB | polychlorinated biphenyl |
| pCi | picocurie (one-trillionth of a curie) |
| pCi/L | picocuries per liter |
| $PM_{10}$ | particulate matter (less than 10 microns in diameter) |
| ppb | parts per billion |
| ppm | parts per million |
| ppbv | parts per billion by volume |
| rem | roentgen equivalent man |
| s | seconds |
| $SO_2$ | sulfur dioxide |
| T | short ton |
| t | metric tons |
| TCA | 1, 1, 1-trichloroethane |
| TCE | trichloroethylene |
| $yd^3$ | cubic yards |
| yr | year |
| µCi | microcurie (one-millionth of a curie) |
| µCi/g | microcuries per gram |
| µg | microgram (one-millionth of a gram) |
| µg/kg | micrograms per kilogram |
| µg/L | micrograms per liter |
| $\mu g/m^3$ | micrograms per cubic meter |

# CONVERSION CHART

| To Convert Into Metric | | | To Convert Into English | | |
|---|---|---|---|---|---|
| **If You Know** | **Multiply By** | **To Get** | **If You Know** | **Multiply By** | **To Get** |
| **Length** | | | | | |
| inch | 2.54 | centimeter | centimeter | 0.3937 | inch |
| feet | 30.48 | centimeter | centimeter | 0.0328 | feet |
| feet | 0.3048 | meter | meter | 3.281 | feet |
| yard | 0.9144 | meter | meter | 1.0936 | yard |
| mile | 1.60934 | kilometer | kilometer | 0.62414 | mile |
| **Area** | | | | | |
| square inch | 6.4516 | square centimeter | square centimeter | 0.155 | square inch |
| square feet | 0.092903 | square meter | square meter | 10.7639 | square feet |
| square yard | 0.8361 | square meter | square meter | 1.196 | square yard |
| acre | 0.40469 | hectare | hectare | 2.471 | acre |
| square mile | 2.58999 | square kilometer | square kilometer | 0.3861 | square mile |
| **Volume** | | | | | |
| fluid ounce | 29.574 | milliliter | milliliter | 0.0338 | fluid ounce |
| gallon | 3.7854 | liter | liter | 0.26417 | gallon |
| cubic feet | 0.028317 | cubic meter | cubic meter | 35.315 | cubic feet |
| cubic yard | 0.76455 | cubic meter | cubic meter | 1.308 | cubic yard |
| **Weight** | | | | | |
| ounce | 28.3495 | gram | gram | 0.03527 | ounce |
| pound | 0.45360 | kilogram | kilogram | 2.2046 | pound |
| short ton | 0.90718 | metric ton | metric ton | 1.1023 | short ton |
| **Force** | | | | | |
| dyne | 0.00001 | newton | newton | 100,000 | dyne |
| **Temperature** | | | | | |
| Fahrenheit | Subtract 32 then multiply by 5/9ths | Celsius | Celsius | Multiply by 9/5ths, then add 32 | Fahrenheit |

# 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 | = | $10^{3}$ |
| hecto- | h | l00 | = | $10^{2}$ |
| deka- | da | l0 | = | $10^{1}$ |
| 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 | = | $10^{-12}$ |
| femto- | f | 0.000 000 000 000 001 | = | $10^{-15}$ |
| atto- | a | 0.000 000 000 000 000 001 | = | $10^{-18}$ |