NBL Program Office
U. S. Department of Energy

SAFETY DATA SHEET
URANYL NITRATE SOLUTION CONTAINING ^{233}U

SECTION 1: CHEMICAL PRODUCTS & COMPANY IDENTIFICATION

NBL Program Office
U. S. Department of Energy,
1 Science.gov Way,
Oak Ridge, TN 37830
1-865-576-0598

Off Hours Emergency Numbers:

1-865-576-0598

Substance: Uranyl Nitrate Solution

Trade Names/Synonyms:

URANYL NITRATE IN NITRIC ACID SOLUTION; CRM 111-A; CRM 111, CRM 117

Chemical Family:
Mixture inorganic acid/inorganic salt

Radioactive 

SECTION 2: HAZARDS IDENTIFICATION

OSHA Hazards
Oxidizer, Highly toxic by inhalation, Highly toxic by ingestion.

Target Organs
Kidney, Liver, Lungs, Brain. Kidney, Liver, Lungs, Brain.

GHS Classification
Oxidizing solids (Category 2)
Acute toxicity, Oral (Category 2)
Acute toxicity, Inhalation (Category 2)
Specific target organ toxicity - repeated exposure (Category 2)
Acute aquatic toxicity (Category 2)
Chronic aquatic toxicity (Category 2)

GHS Label elements, including precautionary statements

Pictogram

Signal Word: Danger

Hazard statement(s)
H272 May intensify fire; oxidizer.
H300 + H330 Fatal if swallowed or if inhaled
H373 May cause damage to organs through prolonged or repeated exposure.
H411 Toxic to aquatic life with long lasting effects.

Precautionary statement(s)
P220 Keep/Store away from clothing/ combustible materials.
P260 Do not breathe dust/ fume/ gas/ mist/ vapors/ spray.
P264 Wash hands thoroughly after handling.
P273 Avoid release to the environment.
P284 Wear respiratory protection.
P310 Immediately call a POISON CENTER or doctor/ physician if swallowed or inhaled.

Other Hazard(s): Radioactive

CERCLA Ratings (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=1
PERSISTENCE = 3

NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

EMERGENCY OVERVIEW:

Yellow Liquid - Causes severe burns to mucous membranes. Causes respiratory tract, skin and eye burns. May damage the lungs. May affect the central nervous system. May cause adverse reproductive effects. Do not breathe vapor or mist. Do not get in eyes, on skin, or on clothing. Keep storage container tightly closed. Wash thoroughly after handling. Handle with caution, normally in a glove boxtype enclosure.

POTENTIAL HEALTH EFFECTS:

With all modes of exposure, short-term effects are due primarily to nitric acid.

INHALATION:
Short Term Effects: May cause burns, coughing, drooling, tightness in the chest, low blood pressure, headache, weakness, dizziness, lung congestion, and pulmonary edema. Additional effects from inhalation of soluble uranium compounds include kidney damage, blood disorders, and loss of appetite, nausea, vomiting, diarrhea, and convulsions.

Long term effects: In addition to effects from short-term exposure, cancer, anemia and cataracts may occur due to uranium exposure. Tooth decay, digestive disorders and lung damage may result from inhalation of nitric acid vapors and mists.

SKIN CONTACT:
Short term effects: May cause burns, redness and swelling of skin. May also cause yellow or brown stains. In extreme cases, kidney damage and neurological effects may result.

Long term effects: Same as short-term effects.

EYE CONTACT:
Short term effects: May cause burns. Additionally, tearing, redness of the eye, and intolerance to light may result.

Long term effects: Prolonged exposure of the cornea to radiation may result in cataracts; however, it is expected that the nitric acid component of the solution would limit any radiation exposure of the eye to sub-clinical levels.

INGESTION:
Short term effects: May cause burns, tooth damage, yellow or brown stains, fever, vomiting, diarrhea, suffocation and kidney damage.

Long term effects: Same as short-term effects.

CARCINOGEN STATUS:

OSHA:	N
NTP:	N
IARC:	N

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Component: Uranyl Nitrate, $UO_2(NO_3)_2$
CAS Number: 10102-06-4

Percentage: < 0.1% (0.5 mg Uranium/g Solution)
Enrichment CRM 111-A: 99.5 Atom % ^{233}U
Enrichment CRM 117: 33 Atom % each ^{233}U, ^{235}U, and ^{238}U

Component: Nitric Acid, HNO_3
CAS Number: 7697-37-2
Percentage CRM 111-A: 5% (0.8 *N*)
Percentage CRM 117: 50% (8.0 *N*)

Balance: Water

SECTION 4: FIRST AID MEASURES

INHALATION: Remove from exposure area to a restricted area with fresh air as quicklyas possible. If breathing has stopped, perform artificial respiration or administer oxygen; however, this may result in exposure to the person rendering first aid. Any evidence of serious contamination indicates that treatment must be instituted. (Inhalation of radioactive particles may indicate that other parts of the body were also contaminated, such as the digestive tract, skin and eyes.) If time permits, wipe the face with wet filter paper, force coughing and blowing of the nose. Get medical attention immediately. The victim may be contaminated with radioactive particles. Decontaminate any radiologic contamination after individual is stabilized from initial medical treatment. Any personnel involved in rendering first aid must be monitored for radioactivity and thoroughly decontaminated if necessary. Note: U^{233} in gram quantities is primarily considered an alpha emitter. Personnel who are trained in the use of alpha survey instruments and are familiar with the potential problems and hazards involved should only perform monitoring for U^{233} surface contamination. Monitoring for internal contamination requires specialized equipment and expert personnel.

SKIN CONTACT: Remove clothing and shoes immediately. Remove victim to a suitable area for decontamination as quickly as possible. Thoroughly wash the victim with soap and water, paying particular attention to the head, fingernails and palms of the hands. Upon completion of washing, monitor the victim for radioactivity. It is imperative that the skin should be decontaminated as quickly as possible. Minute skin injuries greatly increase the danger of isotope penetration into the victim; shaving should not be attempted. If water and soap have been inadequate in removing the radioactive compound, decontaminating compounds consisting of surfactants and absorbent substances may be effective. Complexing reagents may also be of use. The use of organic solvents is to be avoided. Organic solvents are incompatible with nitric acid and they may increase the solubility and absorption of the radioactive substance. Skin contamination with radiation may be an indication that other parts of the body have been exposed. Contaminated clothing must be stored for later decontamination or disposal. The water used to wash the victim must be

stored for later disposal. Any personnel involved in rendering first aid to the victim must be monitored for radioactivity and decontaminated if necessary. In case of chemical burns, cover area with sterile dry dressing. Bandage securely, but not tightly. Get medical attention immediately.

EYE CONTACT: Remove victim to a restricted area for decontamination. Thoroughly wash eyes with large amounts of water, occasionally lifting the upper and lower lids (at least 15-20 minutes). Following the water treatment, continue irrigating with normal saline for 30-60 minutes. Cover with sterile bandage. Get medical attention immediately. Monitor the victim for radioactivity. If activity is present, rewash the eyes, and remonitor until little or no radioactivity is present. Get medical attention immediately. Any water used to wash the victim's eyes must be stored for later disposal. Any other articles that are used to decontaminate the victim must also be stored for later decontamination or disposal. Any personnel involved in rendering first aid to the victim must be monitored for radioactivity and decontaminated if necessary.

INGESTION: Never give anything by mouth to an unconscious person. Rinse mouth, spitting out the first rinse. Subsequently, the victim should drink large quantities of water or milk to dilute the acid. If vomiting occurs, the head should be kept below the hips to reduce the likelihood of aspiration. Following vomiting, more water or milk should be consumed. The victim should be immediately transferred to a medical facility to have his stomach pumped. Stomach contents should be saved for monitoring. Any personnel involved in rendering first aid to the victim must be monitored for radioactivity and decontaminated if necessary.

NOTE TO PHYSICIAN:

There is no specific antidote for nitric acid. Treat symptomatically and supportively. Chelation of uranium is not recommended as it increases the kidney burden to greater than would be received with no treatment.

SECTION 5: FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD: Negligible fire hazard when exposed to heat or flame.

Contact with organic or combustible materials may result in violent reaction.

Oxidizer: Oxidizers decompose, especially when heated, to yield oxygen or other gases which will increase the burning rate of combustible matter. Contact with easily oxidizable, organic, or other combustible materials may result in ignition, violent combustion or explosion.

EXTINGUISHING MEDIA: Dry chemical, carbon dioxide, water spray or regular foam (most recent Emergency *Response Guidebook*, (ERG), developed jointly by Transport Canada (TC), the U. S. Department of Transportation (DOT) and the Secretariat of Transportation and Communications of Mexico (SCT).)

For larger fires, use water sprays or fog (flooding amounts). Refer to most recent *Emergency Response Guidebook*, ERG.

FIREFIGHTING: Move container from fire area if you can do it without risk (most recent Emergency *Response Guidebook*, ERG).

Flood with water. Contact local, State or Department of Energy radiological response team. Cool containers with flooding quantities of water applied from as far a distance as possible. Avoid breathing dust and fumes; keep upwind. Keep people out of area until area declared safe by proper authorities. Evacuate to a radius of 2500 feet for uncontrollable fires.

HAZARDOUS COMBUSTION PRODUCTS: Thermal decomposition products may include toxic oxides of nitrogen. Vapors may be corrosive. Wear NIOSH/MSHA approved self-contained breathing apparatus and acid resistant clothing, boots and gloves.

SECTION 6: ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL: Call radiation and chemical safety personnel for assistance. For small spills, neutralize acid and take up with vermiculite, sand, or other absorbent material. Isolate the area to prevent unnecessary access by non-essential personnel. Neutralize acid if there is sufficient ventilation, and take up with absorbent materials. Following any clean-up activities, the area must be monitored for radioactive contamination. Contaminated cleaning supplies must be disposed of as radioactive waste.

SOIL SPILL: Call radiation safety personnel. Contain spill and mix with absorbent material. Remove contaminated materials for disposal as radioactive waste.

WATER SPILL: Call radiation safety personnel. Clean site of contamination. Solution may be neutralized by addition of a weak base (e.g., sodium bicarbonate).

Reportable Quantity (RQ): 100 pounds uranyl nitrate, 1000 pounds nitric acid. The Superfund Amendments Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity for this substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2675 in the metropolitan Washington, D.C. area (40 CFR 302.6).

SECTION 7: HANDLING AND STORAGE

Observe all Federal, state and local regulations regarding storage of this material.

Store separately from bases, metallic powders, oxidizable materials and other incompatible substances (see section 10).

Store in radioactive materials area.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE LIMITS:
Uranium, soluble compounds (As U):

0.05 mg/m^3 OSHA TWA
0.2 mg/m^3 ACGIH TLV TWA; 0.6 mg/m^3 ACGIH STEL
0.05 mg/m^3 NIOSH Recommended TWA

Nitric Acid

5.2 mg/m^3 (2 ppm) OSHA PEL (TWA)
5.2 mg/m^3 (2 ppm) ACGIH TLV (TWA); 10 mg/m^3 ACGIH STEL
5.2 mg/m^3 (2 ppm) NIOSH recounted TWA; 10 mg/m^3 NIOSH Recommended STEL
100 PPM is considered immediately dangerous to life and health (IDLH)

URANYL NITRATE SOLUTION:

Occupational exposure to radioactive substances must adhere to standards established by the Occupational Safety and Health Administration, 29 CFR 1910.96, and/or the Nuclear Regulatory Commission, 10 CFR Part 20 and/or CFR Part 8935 Department of Energy.

VENTILATION: Local exhaust or process enclosure ventilation should be provided to reduce nitric acid levels below airborne exposure limits; a more stringent ventilation system may be necessary to comply with radiation exposure limits set forth by law (10 CFR 20.103; 29 CFR 1910.96 or 10 CFR 835) or by internal requirements. In particular, a High Efficiency Particulate Air (HEPA) filtration system may be required for handling and storing this material.

SHIELDING:

ALPHA PARTICLES: For the energy range of alpha particles usually encountered, a fraction of a millimeter of any ordinary material or a few inches of air is sufficient for absorbance.

BETA PARTICLES: Beta particles are more penetrating than alpha, and require more shielding. Materials composed mostly of elements of low atomic number such as acrylic, and thick rubber are most appropriate for the absorption of beta particles. Uranium does not emit significant amounts of beta particles.

GAMMA RAYS: The most suitable materials shielding gamma radiation are lead and iron. These solutions do not emit significant amounts of gamma radiation. Consult a radiation protection specialist or health physicist for more information.

EYE PROTECTION: Employee must wear appropriate eye protection that will not allow the introduction of foreign material into the eyes. Contact lenses should not be worn. Safety goggles are recommended when opening ampoules or if exposure to nitric acid vapors is possible.

Clothing, glove and eye protection equipment will provide protection against alpha particles, and some protection against beta particles; depending on thickness, personal protection equipment will not shield gamma radiation.

CLOTHING: Disposable over garments, including foot covering (and head covering as necessary), should be worn by any employee engaged in handling ^{233}U-containing materials. These garments are recommended even if the employee is working with a glovebox containment system.

In the event of an accident, large-scale release or a large-scale clean-up full protective clothing will be necessary.

GLOVES: Employee should wear appropriate protective gloves during transfer, fuming and other operations where contamination is possible. Used gloves should be disposed of as radioactive waste.

RESPIRATOR: If exposure to corrosive vapors, toxic oxides of nitrogen, or particulates of uranium material is possible, a respirator with acid and/or particulate cartridges should be used. Nitric acid is an oxidizer. Do not use cartridges containing oxidizable materials such as activated charcoal.

Follow guidelines contained in NIOSH Pocket Guide Chemical hazards and 29 CFR 1910, Subpart Z.

Escape - Any air-purifying full facepiece respirator with a high-efficiency particulate filter. Any escape-type self-contained breathing apparatus.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS: Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive pressure mode.

Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: yellow aqueous solution
MOLECULAR WEIGHT: N/A
MOLECULAR FORMULA: Mixture
BOILING POINT: Approximately 100°C (212°F)
MELTING POINT: Approximately 0°C (32°F)
SPECIFIC GRAVITY: Approximately 1.02
WATER SOLUBILITY: 100%
SOLVENT SOLUBILITY: Avoid organic solvents. See incompatibilities, Section 10.

The half-lives of the various uranium isotopes are as follows:
^{233} U $^{=}$ 1.59 X $10^{5;}$; ^{235}U = 7.04 X 10^{8} y; ^{238}U = 4.51 X 10^{9} y.

The specific activities of the various uranium isotopes are as follows:
^{233}U = 3.6 X 10^{2} MBq/g (9.7 X 10^{-3} Ci/g)
^{235}U = 7.8 X 10^{-2} MBq/g (2.1 X 10^{-6} Ci/g)
^{238}U = 1.2 X 10^{-2} MBq/g (3.3 X 10^{-7} Ci/g)

SECTION 10: STABILITY AND REACTIVITY

INCOMPATIBILITIES:
ACETIC ACID: May react explosively.
ACETIC ANHYDRIDE: Explosive reaction by friction or impact.
ACETONE: May react explosively.
ACETONITRILE: Explosive mixture.
4-ACETOXY-3-METHOXYBENZALDEHYDE: Exothermic reaction.
ACROLEIN: Temperature and pressure increase in closed container.
ACRYLONITRILE: Explosive reaction at 90°C.
ACRYLONITRILE-METHACRYLATE COPOLYMER: Incompatible.

ALCOHOLS: Possible violent reaction or explosion; formation of explosive compound in the presence of heavy metals.
ALKANETHIOLS: Exothermic reaction with possible ignition.
2-ALKOXY-1.3-DITHIA-2-PHOSPHOLANE: Ignition reaction.
ALLYL ALCOHOL: Temperature and pressure increase in closed container.
ALLYL CHLORIDE: Temperature and pressure increase in closed container.
AMINES (ALIPHATIC OR AROMATIC): Possible ignition reaction.
2-AMINOETHANOL: Temperature and pressure increase in closed container.
2-AMINOTHIAZOLE: Explosive reaction.
AMMONIA (GAS): Burns in an atmosphere of nitric acid vapor.
AMMONIUM HYDROXIDE: Temperature and pressure increase in closed container.
AMMONIUM NITRATE: Forms explosive mixture.
ANILINE: Ignites on contact.
ANILINIUM NITRATE: Forms explosive solution.
ANION EXCHANGE RESINS: Possible violent exothermic reaction.
ANTIMONY: Violent reaction.
ARSINE: Explosive reaction.
ARSINE-BORON TRIBROMIDE: Violent oxidation.
BASES: Reacts, sometimes vigorously and exothermically.
BENZENE: Explosive reaction.
BENZIDINE: Spontaneous ignition.
BENZONITRILE: Possible explosion.
BENZOTHIOPHENE DERIVATIVES: Formation of possibly explosive compounds.
N-BENZYL-N-ETHYLANILINE: Vigorous decomposition.
1,4-BIS (METHOXYMETHYL)2,3,5,6 - TETRAMETHYLBENZENE: Gas evolution.
BISMUTH: Intense exothermic reaction or explosion.
1,3-BIS(TRIFLUOROMETHYL)BENZENE: Possible explosion.
BORON: Violent reaction with incandescence.
BORON DECAHYDRIDE: Explosive reaction.
BORON PHOSPHIDE: Ignition reaction.
BROMINE PENTAFLUORIDE: Ignition reaction.
N-BUTYL MERCAPTAN: Ignition reaction.
N-BUTYRALDEHYDE: Temperature and pressure increase in closed container.
CADMIUM PHOSPHIDE: Explosive reaction.
CALCIUM HYPOPHOSPHITE: Ignition reaction.
CARBON (PULVERIZED): Violent reaction.
CELLULOSE: Forms easily combustible ester.
CHLORATES: Reacts.
CHLORINE: Incompatible.
CHLORINE TRIFLUORIDE: Violent reaction.
CHLOROBENZENE: Possible explosion.
4-CHLORO-2-NITROANILINE: Forms explosive compound.
CHLOROSULFONIC ACID: Temperature and pressure increase in closed container.
COAL: Explosive mixture.

COATINGS: May be attacked.
CRESOL: Temperature and pressure increase in closed container.
CROTONALYDEHYDE: Violent decomposition with ignition.
CUMENE: Temperature and pressure increase in closed container.
CUPRIC NITRIDE: Explosive reaction.
CUPROUS NITRIDE: Violent reaction.
CYANATES: Possible explosive reaction.
CYCLOHEXANONE: Violent reaction.
CYCLOHEXYLAMINE: Forms explosive compound.
CYCLOPENTADIENE: Explosive reaction.
1,2-DIAMINOETHANEBIS(TRIMETHYLGOLD): Explosive reaction.
DIBORANE: Spontaneous ignition.
DI-2-BUTOXYETHYL ETHER: Violent decomposition reaction.
2,6-DI-T-BUTYL PHENOL: Formation of explosive compound.
DICHLOROETHANE: Forms shock and heat sensitive mixture.
DICHLOROETHYLENE: Forms explosive solution.
DICHLOROMETHANE: Forms explosive solution.
DICYCLOPENTADIENE: Spontaneous ignition.
DIENES: Ignition reaction.
DIETHYLAMINO ETHANOL: Possible explosion.
DIETHYL ETHER: Possible explosion.
3,6-DIHYDRO-1,2,2H-OXAZINE: Explosive interaction.
DIISOPROPYL ETHER: Temperature and pressure increase in closed container.
DIMETHYLAMINOMETHYLFERROCENE: Violent decomposition if heated.
DIMETHYL ETHER: Forms explosive compound.
DIMETHYL HYDRZINE: Ignites on contact.
DIMETHYL SULFOXIDE + 1,4-DIOXANE: Explosion.
DIMETHYL SULFOXIDE + <14% WATER: Explosive reaction.
DINITROBENZENE: Explosion hazard.
DINITROTOLUENE: Explosive reaction.
DIOXANE + PERCHLORIC ACID: Possible explosion.
DIPHENYL DISTIBENE: Explosive oxidation.
DIPHENYL MERCURY + CARBON DISULFIDE: Violent reaction.
DIPHENYL TIN: Ignition reaction.
DISODIUM PHENYL ORTHOPHOSPHATE: Violent explosion.
DIVINYL ETHER: Possible ignition reaction.
EPICHLOROHYDRIN: Temperature and pressure increase in closed container.
ETHANESULFONAMIDE: Explosive reaction.
ETHOXY-ETHYLENE DITHIOPHOSPHATE: Ignition on contact.
M-ETHYL ANILINE: Ignition reaction.
ETHYLENE DIAMINE: Temperature and pressure increase in closed container.
ETHYLENE GLYCOL: Forms shock and heat sensitive mixture.
ETHYLENEIMINE: Temperature and pressure increase in closed container.
5-ETHYL-2-METHYL PYRIDINE: Explosive reaction.

ETHYL PHOSPHINE: Ignition reaction.
5-ETHYL-2-PICOLINE: Forms explosive compounds.
FERROUS OXIDE (POWDERED): Intense exothermic reaction.
FLUORINE: Possible explosive reaction.
FORMIC ACID: Exothermic reaction with release of toxic gases.
2-FORMLAMINO-1-PHENYL-1,3-PROPANEDIOL: Possible explosion.
FUEL OIL (BURNING): Explosion.
FULMINATES: Reacts.
FURFURYLIDENE KETONES: Ignites on contact.
GERMANIUM: Violent reaction.
GLYCEROL: Possible explosion.
GLYOXAL: Temperature and pressure increase in closed container.
HEXALITHIUM DISILICIDE: Explosive reaction.
HEXAMETHYLBENZENE: Possible explosion.
2,2,4,4,6,6-HEXAMETHYLTRITHIANE: Explosive oxidation.
HEXENAL: Explodes on heating
HYDRAZINE: Violent reaction.
HYDRAZOIC ACID: Energetic reaction.
HYDROGEN IODIDE: Ignition reaction.
HYDROGEN PEROXIDE: Forms unstable mixture.
HYGROGEN PEROXIDE AND KETONES: Forms explosive products.
HYDROGEN PEROXIDE AND MERCURIC OXIDE: Forms explosive compounds.
HYDROGEN PEROXIDE AND THIOUREA: Forms explosive compounds.
HYDROGEN SELENIDE: Ignition reaction.
HYDROGEN SULFIDE: Incandescent reaction.
HYDROGEN TELLURIDE: Ignition and possible explosive reaction.
INDANE AND SULFURIC ACID: Explosive reaction.
ISOPRENE: Temperature and pressure increase in closed container.
KETONES (CYCLIC): Violent reaction.
LACTIC ACID + HYDROFLUORIC ACID: Explosive reaction.
LITHIUM: Ignition reaction.
LITHIUM SILICIDE: Incandescent reaction.
MAGNESIUM: Explosive reaction.
MAGNESIUM + 2-NITROANILINE: May ignite on contact.
MAGNESIUM PHOSPHIDE: Incandescent reaction.
MAGNESIUM SILICIDE: Violent reaction.
MAGNESIUM-TITANIUM ALLOY: Forms shock and heat sensitive mixture.
MANGANESE (POWERED): Incandescence and possible explosion.
MESITYL OXIDE: Temperature and pressure increase in closed container.
MESITYLENE: Possible explosive reaction.
METALS: Violent reaction with explosion or ignition.
METAL ACETYLIDES: Violent or explosive reaction.
METAL CARBIDES: Violent or explosive reaction.
METAL CYANIDES: Explosive reactions.

METAL FERRICYANIDE OR FERROCYANIDE: Violent reaction.
METAL SALICYLATES: Forms explosive compounds.
METAL THIOCYANATES: Possible explosion.
2-METHYLBENZIMIDAZOLE + SULFURIC ACID: Possible explosive reaction.
4-METHYLCYCLOHEZANONE: Explosive reaction.
2-METHYL-5-ETHYLPYRIDINE: Temperature and pressure increase in closed container.
METHYL THIOPHENE: Ignition reaction.
NEODYMIUM PHOSPHIDE: Violent reaction.
NICKEL TETRAPHOSPHIDE: Ignition reaction.
NITRO AROMATIC HYDROCARBONS: Forms highly explosive products
NITROBENZENE: Explosive reaction, especially in the presence of water.
NITROMETHANE: Explosive reaction.
NITRONAPHTHALENE: Explosion hazard.
NON-METAL OXIDES: Explosive reaction.
OLEUM: Temperature and pressure increase in closed container.
ORGANIC MATERIALS: Fire and explosion hazard.
ORGANIC SUBSTANCES AND PERCHLORATES: Possible explosion.
ORGANIC SUBSTANCES AND SULFURIC ACID: Possible explosion.
PHENYL ACETYLENE + 1,1 DIMETHYLHYDRAZINE: Violent reaction.
PHENYL ORTHOPHOSPHORIC ACID DISODIUM SALT: Forms explosive products.
PHOSPHINE + OXYGEN: Spontaneous ignition.
PHOSPHONIUM IODIDE: Ignition reaction.
PHOSPHORUS (VAPOR): Ignites when heated.
PHOSPHOROUS HALIDES: Ignition reaction.
PHOSPHOROUS TETRAIODIDE: Vigorous reaction.
PHOSPHOROUS TRICHLORIDE: Explosive reaction.
PHTHALIC ACID AND SULFURIC ACID: Possible explosive reaction.
PHTHALIC ANHYDRIDE: Exothermic reaction and forms explosive products.
PICRATES: Reacts.
PLASTICS: May be attacked.
POLYALKENES: Intense reaction.
POLYDIBROMOSILANES: Explosive reaction.
POLY(ETHYLENE OXIDE) DERIVATIVES: Possible explosion.
POLYPROPYLENE: Temperature and pressure increase in a closed container.
POLY(SILYLENE): Ignition.
POLYURETHANE (FOAM): Vigorous reaction.
POTASSIUM HYPOPHOSPHITE: Explosive reaction.
POTASSIUM PHOSPHINATE: Explodes on evaporation.
β-PROPIOLACTONE: Temperature and pressure increase in closed container.
PROPIOPHENONE + SULFURIC ACID: Exothermic reaction above 5°C.
PROPYLENE GLYCOL + HYDROFLUORIC ACID + SILVER NITRATE: Explosive mixture.

PROPYLENE OXIDE: Temperature and pressure increase in closed container.
PYRIDINE: Temperature and pressure increase in closed container.
PYROCATECHOL: Ignites on contact.
REDUCING AGENTS: Possible explosive or ignition reaction.
RESORCINOL: Possible explosion.
RUBBER: Vigorous reaction, possible explosion.
SELENIUM: Vigorous reaction.
SELENIUM HYDRIDE: Ignition or incandescent reaction.
SELENIUM IODOPHOSPHIDE: Explosive reaction.
SILICON: Violent reaction.
SILICONE OIL: Possible explosion.
SILVER BUTEN-3-YNIDE: Explosion.
SODIUM: Spontaneous ignition.
SODIUM HYDROXIDE: Temperature and pressure increase in a closed container.
STIBINE: Explosive reaction.
SUCROSE (SOLID): Vigorous reaction.
SULFAMIC ACID: Violent reaction with evolution of toxic nitrous oxide.
SULFIDES: Reacts.
SULFUR DIOXIDE: Explosive reaction.
SULFUR HALIDES: Violent reaction.
SULFURIC ACID + GLYCERIDES: Explosive reaction.
SULFURIC ACID + TEREPHTHALIC ACID: Violent reaction.
SURFACTANTS + PHOSPHORIC ACID: Explosion hazard.
TERPENES: Spontaneous ignition.
TETRABORANE: Explosive reaction.
TETRABORANE DECAHYDRIDE: Explosive reaction.
TETRAPHOSPHOROUS DIIODOTRISELENIDE: Explosive reaction.
TETRAPHOSPHOROUS IODIDE: Ignites on contact.
TETRAPHOSPHOROUS TETRAOXIDE TRISULFIDE: Violent reaction.
THIOALDEHYDES: Violent reaction.
THIOKETONES: Violent reaction.
THIOPHENES: Explosive reaction.
TITANIUM: Forms shock-sensitive compound.
TITANIUM ALLOYS: Possible explosive reaction.
TITANIUM-MAGNESIUM ALLOY: Possible explosion on impact.
TOLUENE: Violent reaction.
TOLUIDENE: Ignition reaction.
1,3,5-TRIACETYLHEXAHYDRO-1,3,5-TRIAZINE + TRIFLUOROACETIC ANHYDRIDE: Explosive reaction.
TRIAZINE: Violently explosive reaction.
TRICADMIUM DIPHOSPHIDE: Explosive reaction.
TRIETHYLGALLIUM MONOETHYL ETHER COMPLEX: Ignition reaction.
TRIMETHYLTRIOXANE: Intense reaction.
TRIS(IODOMERCURI)PHOSPHONE: Violent decomposition.

TRITHIOACETONE: Explosive reaction.
TURPENTINE: Explosive mixture.
UNSYMMETRICAL DIMETHYL HYDRAZINE: Spontaneous ignition.
URANIUM: Explosive reaction.
URANIUM ALLOY: Violent reaction.
URANIUM DISULFIDE: Violent reaction.
URANIUM-NEODYMIUM ALLOYS: Explosive reaction.
VINYL ACETATE: Temperature and pressure increase in closed container.
VINYLIDENE CHLORIDE: Temperature and pressure increase in closed container.
WOOD: Possible ignition.
P-XYLENE: Intense reaction in presence of sulfuric acid.
ZINC: Incandescent reaction.
ZINC ETHOXIDE: Possible explosion.
ZIRCONIUM-URANIUM ALLOYS: Explosive reaction.

HAZARDOUS DECOMPOSITION: Thermal decomposition products may include toxic oxides of nitrogen.

POLYMERIZATION: Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION 11: TOXICOLOGY INFORMATION

URANYL NITRATE: Solution.

CARCINOGEN STATUS: None.

Uranium is a heavy metal. Soluble compounds of uranium, such as uranyl nitrate, are toxic to the kidneys. Uranium is a mildly radioactive alpha emitter; large amounts of enriched uranium and ^{233}U constitute a radiation hazard. Radiation may damage the skin, lungs, bone marrow, or the lymphatic system. Because uranium decays by alpha emission, external exposure to this uranyl nitrate solution is unlikely to be a health hazard. However, ingestion or inhalation can cause damage due to the corrosive nature of the solution, the toxicity of the metal or radioactive decay (especially of enriched material).

HEALTH EFFECTS OF INHALATION:
URANYL NITRATE: SOLUTION
RADIOACTIVE.
20 mg/m^3 (Uranyl nitrate, as U) Immediately Dangerous to Life or Health.
100 mg/m^3 (HNO_3) Immediately Dangerous to Life or Health.

ACUTE EXPOSURE: Uranyl nitrate dusts and corrosive acids are irritating to the respiratory tract. Inhalation of acid vapors can cause fatal breathing difficulties.

Decomposition and reaction products of nitric acid include toxic nitrous oxides. Since uranyl nitrate is soluble, inhaled uranium materials may pass into the bloodstream and contribute to kidney damage. The acidosis and azotemia including renal dysfunction may damage the liver. Normal uranium materials are weak alpha emitters; the chemical toxicity may be more relevant than the radioactive hazard.

CHRONIC EXPOSURE: Chronic inhalation of uranyl nitrate may increase the risk of cancer in the soft body tissues.

ALPHA RADIATION:
ACUTE EXPOSURE - Alpha radiation will kill cells immediately adjacent to the source of contact. Large insoluble particles may remain at or near the site of deposition, and cause local damage. Soluble compounds may rapidly enter the bloodstream. The damage depends on how quickly they are eliminated, and the susceptibility of the tissue in which they are stored.

CHRONIC EXPOSURE - The effects of chronic exposure by internally deposited alpha active material is dependent upon the amount, enrichment, and tissue. If large amounts become internally deposited, lung cancer, sterility, anemia, leukemia, or bone cancer may occur.

SKIN CONTACT:
URANYL NITRATE, SOLUTION
RADIOACTIVE/NEPHROTOXIN.
ACUTE EXPOSURE - All soluble uranium compounds, such as uranyl nitrate, are lethal when applied in a single dose to the skin of rabbits, either in various vehicles, or in some cases (probably not uranyl nitrate) when applied without vehicle. The toxicity of uranium compounds is to the kidneys. At lower doses than those required producing lethality the dust might irritate the skin. A hot nitric acid solution of uranyl nitrate spilled on the skin caused skin burns, nephritis, and encephalopathy. Prolonged skin contact with uranium compounds should be avoided because of potential radiation damage to basal cells; see following section regarding alpha radiation.

CHRONIC EXPOSURE - Chronic contact may produce kidney damage, as described above in acute exposure. Prolonged irritation may worsen into dermatitis, result in radiation damage, or increased cancer risk.

ALPHA RADIATION:
ACUTE EXPOSURE - Alpha radiation is not usually an external hazard. However, local damage may occur at the site of a wound. Absorption or penetration through damaged skin may result in internal deposition and increased cancer risk.

CHRONIC EXPOSURE - Prolonged or repeated contact may result in blood disorders and increased risk of cancer.

EYE CONTACT:
URANYL NITRATE, SOLUTION.
ACUTE EXPOSURE - Dust may cause irritation and lacrimation. Soluble uranium compounds may be lethal when placed in the conjunctival sac of the rabbit eye with or without a vehicle.

CHRONIC EXPOSURE - May cause conjunctivitis or cataracts.

ALPHA RADIATION:
ACUTE EXPOSURE - Repeated or prolonged exposure to alpha radiation may result in cataract formation. Of the well-documented late effects of radiation on man, leukemia and cataracts have been observed at doses lower than those producing skin scarring and cancer or bone tumors. The lens of the eye is considered to be a critical organ for exposure to radiation. It is important to note that long-term eye contact with these solutions would most likely result in serious damage to the cornea due to nitric acid long before cataracts would be formed.

CHRONIC EXPOSURE - Repeated or prolonged exposure to alpha radiation may result in cataract formation. See acute exposure.

INGESTION:
URANYL NITRATE, SOLUTION
RADIOACTIVE/NEPHROTOXIN.
ACUTE EXPOSURE - Ingestion of corrosive acids may permanently damage body tissues and teeth. Ingestion of soluble uranium compounds, such as uranyl nitrate, may result in kidney failure and/or radiation damage. One ounce (as the solid) may be fatal.

CHRONIC EXPOSURE - Chronic ingestion may lead to kidney failure, or radioactive destruction of soft tissues, such as bone marrow and kidneys.

ALPHA RADIATION: See "Toxicology Information: Health Effects of Inhalation"

FIRST AID FOR URANIUM COMPOUNDS: Although chelating agents act on uranium, they should not be used because the increased migrant fraction leads through renal precipitation to a greater kidney burden than would be received if there were no treatment at all; there is thus the risk of serious toxic nephritis. The basic treatment should be administration of a bicarbonate solution given locally and in intravenous perfusion (one bottle of 250 mL at 1.4%).

SECTION 12: ECOLOGICAL INFORMATION

Environmental Impact Rating (0-4): 2

Acute Aquatic Toxicity: Yes
Degradability: No data available

Log Bioconcentration Factor (BCF): No data available

Log Octanol/water partition coefficient: No data available

SECTION 13: DISPOSAL INFORMATION

Observe all Federal, State and local Regulations when disposing of this substance.

Disposal must be in accordance with 10 CFR 20 and 60.

SECTION 14: TRANSPORTATION INFORMATION

The U.S. Department of Transportation (D.O.T.) Code of Federal Regulations (49 CFR Parts 100- 185), the International Air Transportation Association (IATA), International Civil Aviation Organization (ICAO) and International Maritime Organization (IMDG) are all factored into the classification and transport of material.

Proper Shipping Name: Hazard Class: UN/ID Number: To be determined on a case by case basis.
Special Information:
Packing Group:

Classification of substances with multiple hazards must be determined in accordance with the criteria presented in the above mentioned regulations. Due to the various quantities/combinations of materials being shipped at one time, the information above must be determined based on the characteristics of the specific shipment.

SECTION 15: REGULATORY INFORMATION

TSCA STATUS: Y

CERCLA SECTION 103 (40 CFR 302.4):	Y
SARA SECTION 302 (40 CFR 355.30):	Y

SARA SECTION 304 (40 CFR 355.40):	Y
SARA SECTION 313 (40 CFR 372.65):	Y
OSHA PROCESS SAFETY (29 CFR 1910.119):	Y
CALIFORNIA PROPOSITION 65:	N

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	Y
FIRE HAZARD:	Y
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	N

SECTION 16: OTHER INFORMATION

This material is prepared for use as a standard or in interlaboratory comparison programs at analytical laboratories, which routinely handle uranium and/or plutonium. The NBL Program Office (NBL PO) assumes that recipients of this material have developed internal safety procedures, which guard against accidental exposure to radioactive and toxic materials, contamination of the laboratory environment, or criticality. NBL PO further expects that personnel who handle radioactive materials have been thoroughly trained in the safety procedures developed by and for their Laboratory.

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