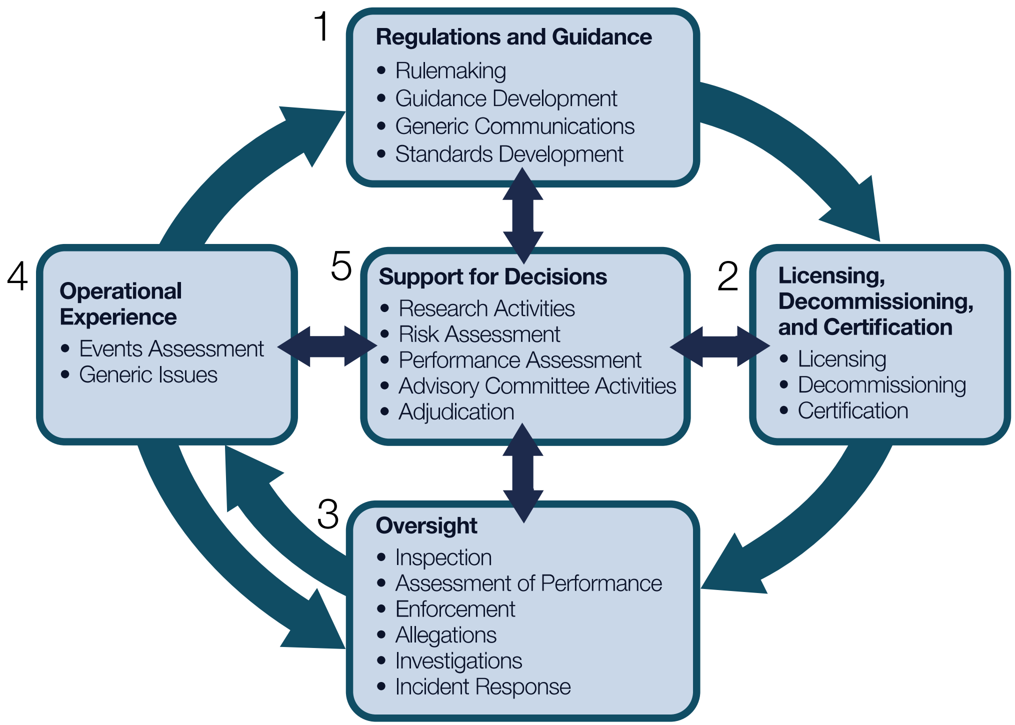
U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

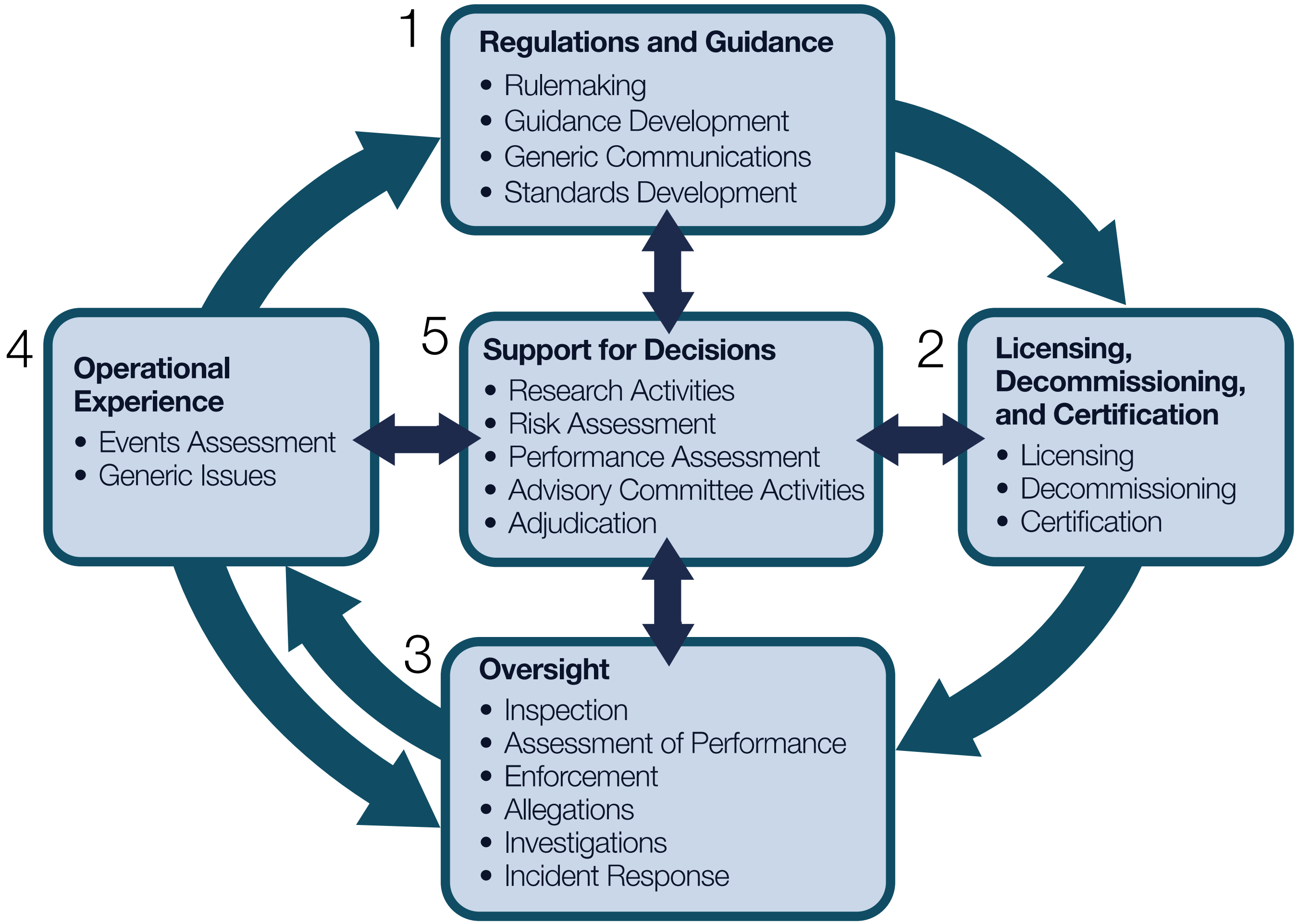
How We Regulate



1. *Developing regulations and guidance for applicants and licensees.*
2. *Licensing or certifying applicants to use nuclear materials, operate nuclear facilities, and decommission facilities.*
3. *Inspecting and assessing licensee operations and facilities to ensure licensees comply with NRC requirements, responding to incidents, investigating allegations of wrongdoing, and taking appropriate followup or enforcement actions when necessary.*
4. *Evaluating operational experience of licensed facilities and activities.*
5. *Conducting research, holding hearings, and obtaining independent reviews to support regulatory decisions.*

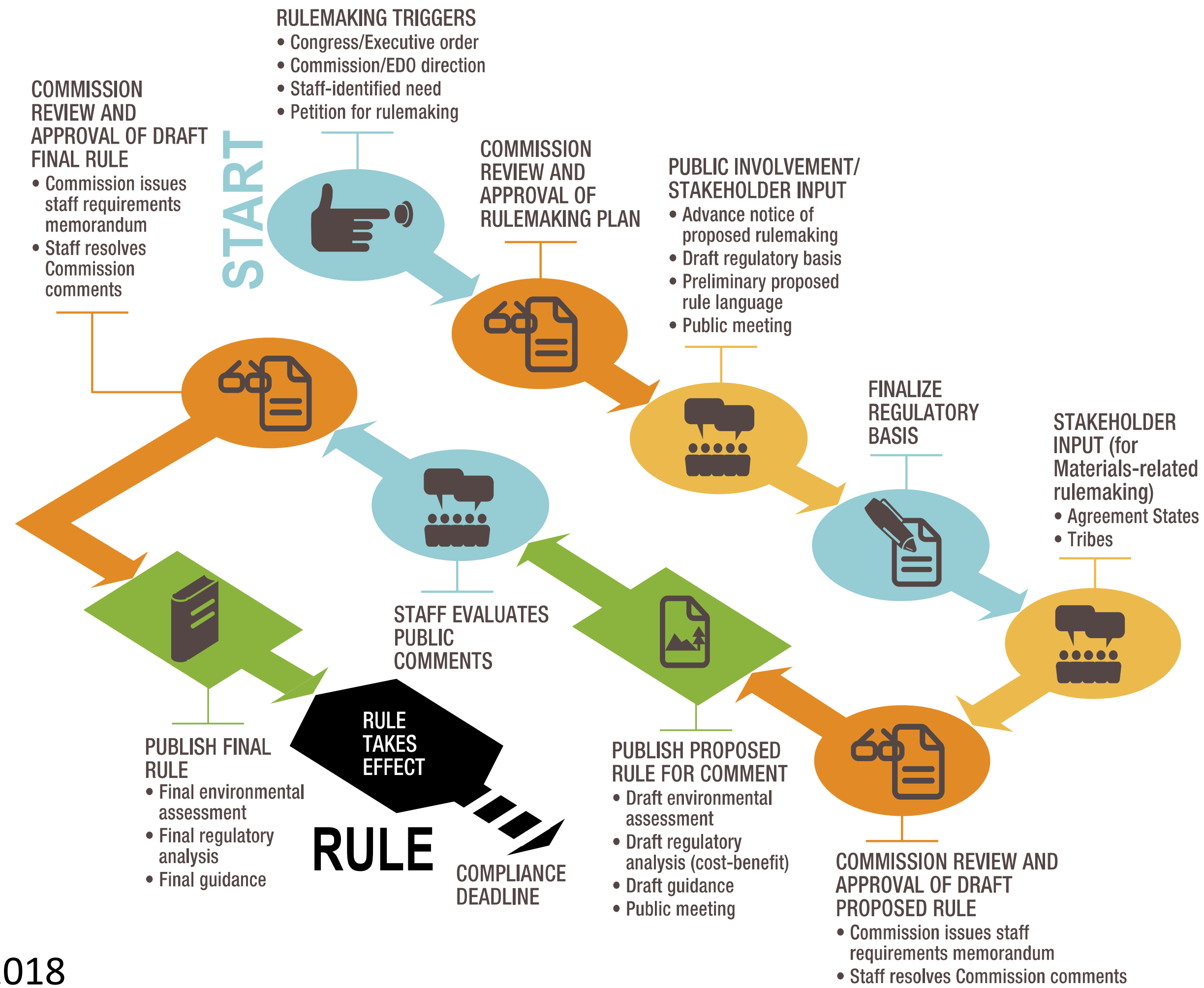
As of July 2018

How We Regulate



As of July 2018

A Typical Rulemaking Process



As of July 2018

Commissioner Term Expiration*

Kristine L. Svinicki
Chairman
June 30, 2022

Jeff Baran
June 30, 2023

Stephen G. Burns
June 30, 2019

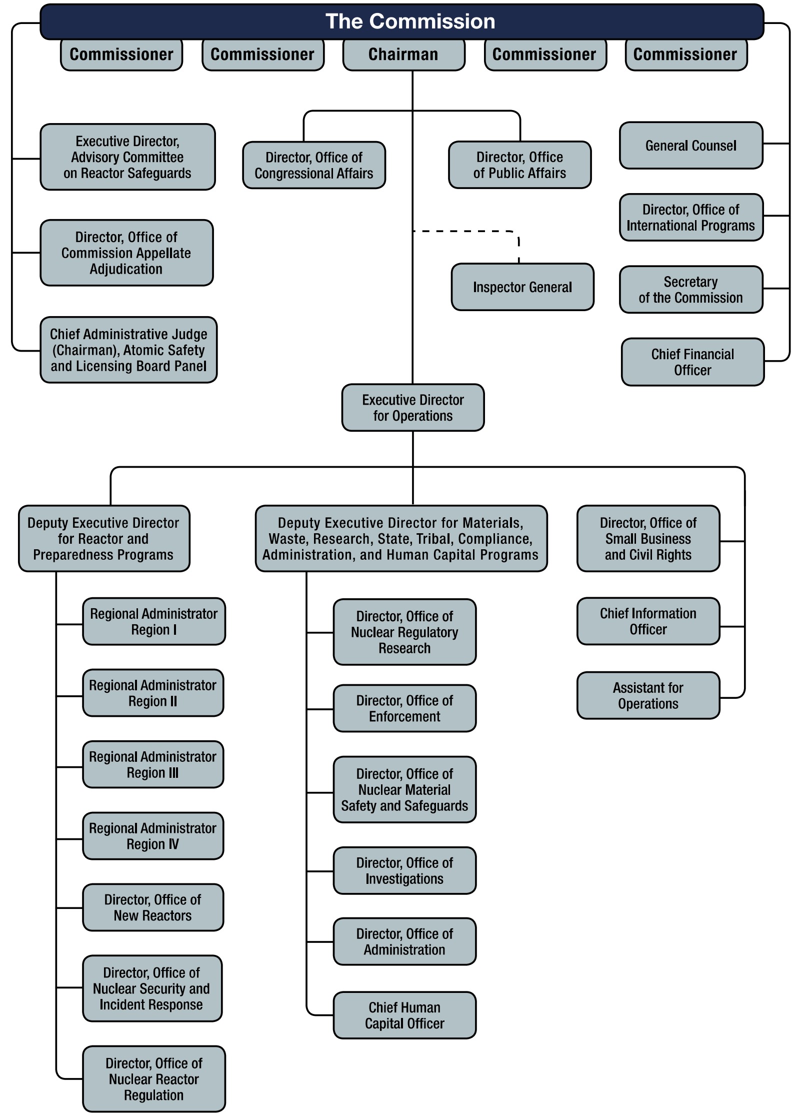
Annie Caputo
June 30, 2021

David A. Wright
June 30, 2020

** Commissioners listed by seniority.*

As of July 2018

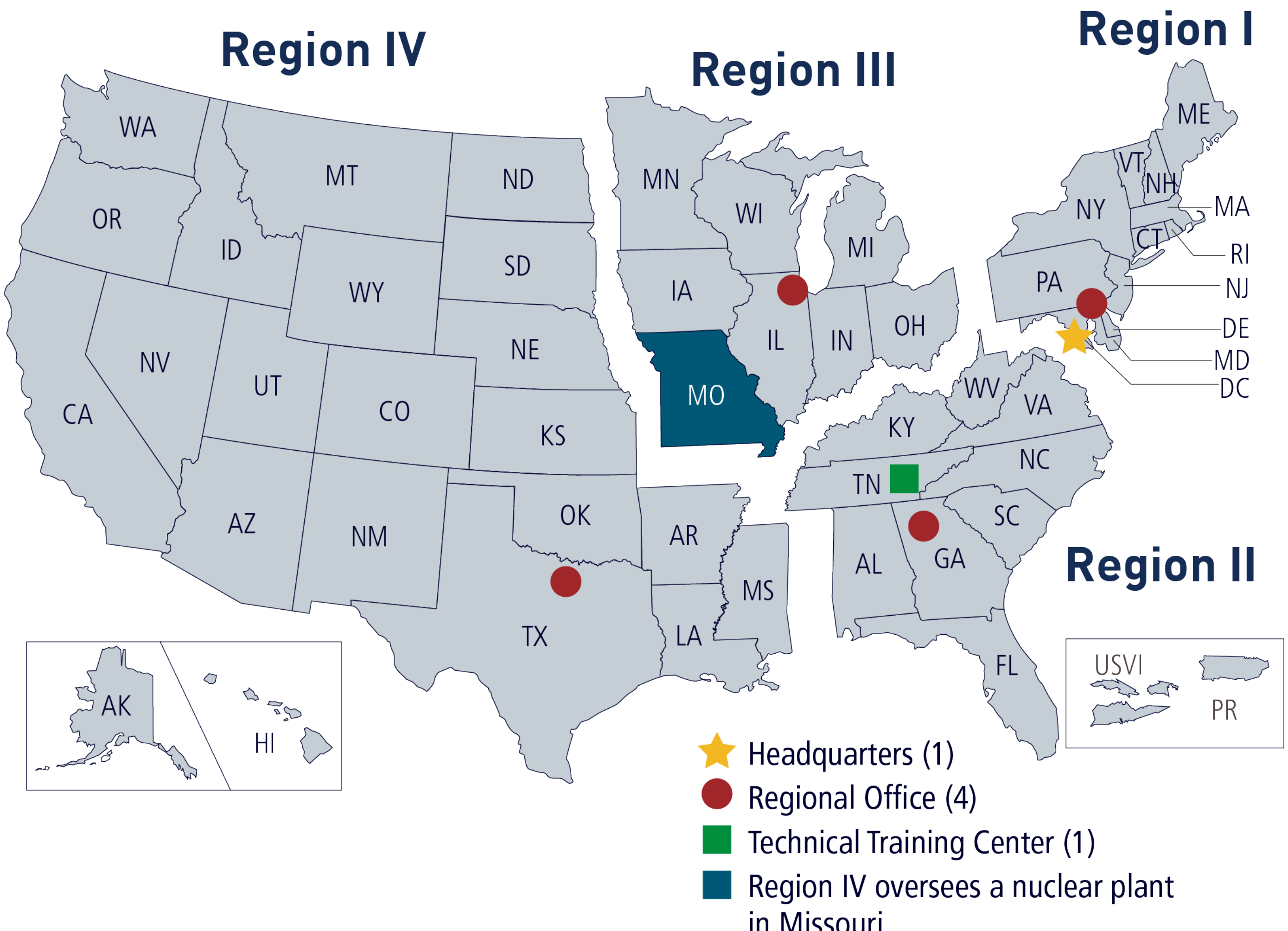
NRC Organization Chart



As of July 2018

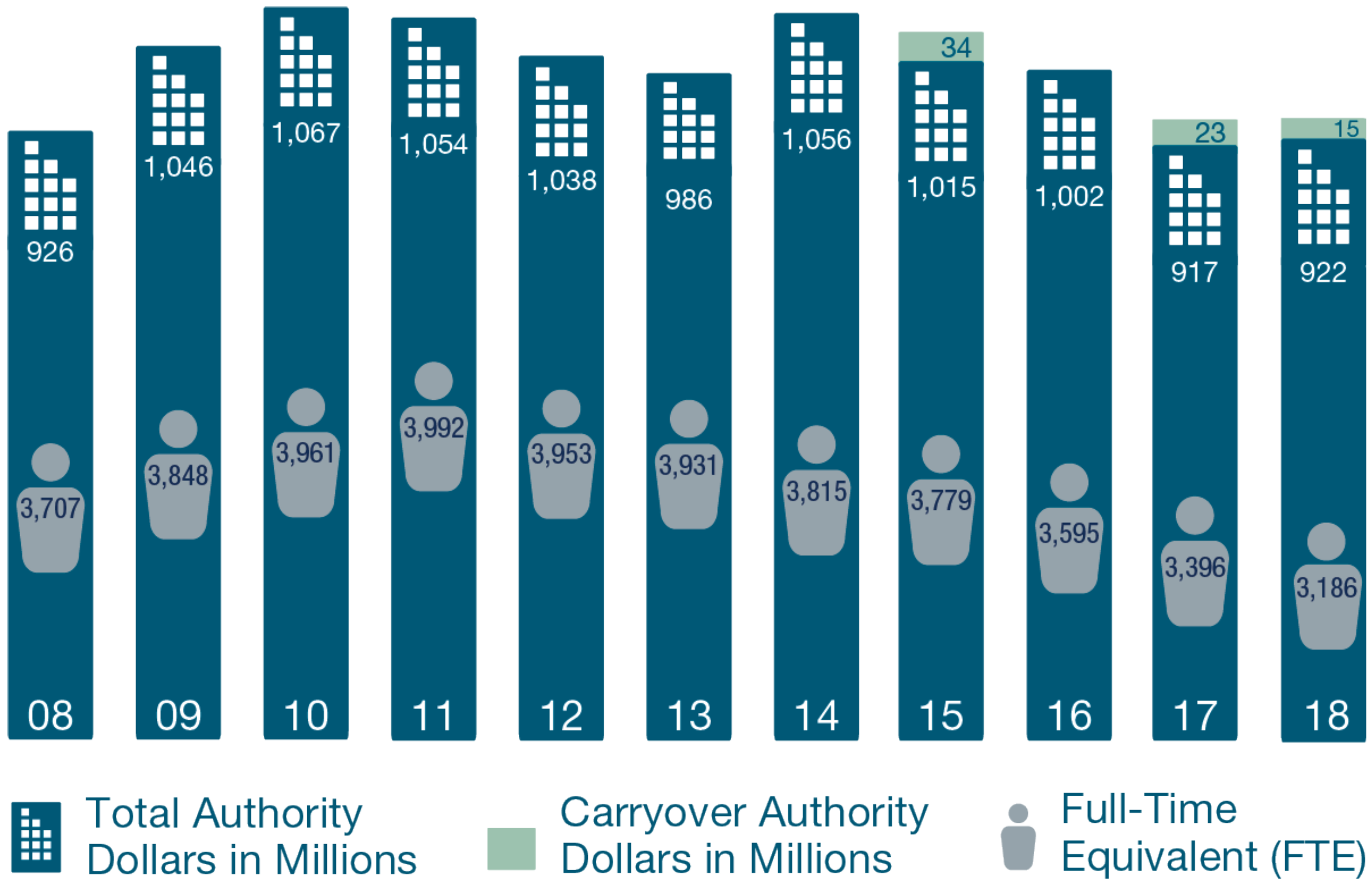
Note: For the most recent information, go to the NRC Organization Chart at https://www.nrc.gov/about-nrc/organization.html .

NRC Regions



As of July 2018

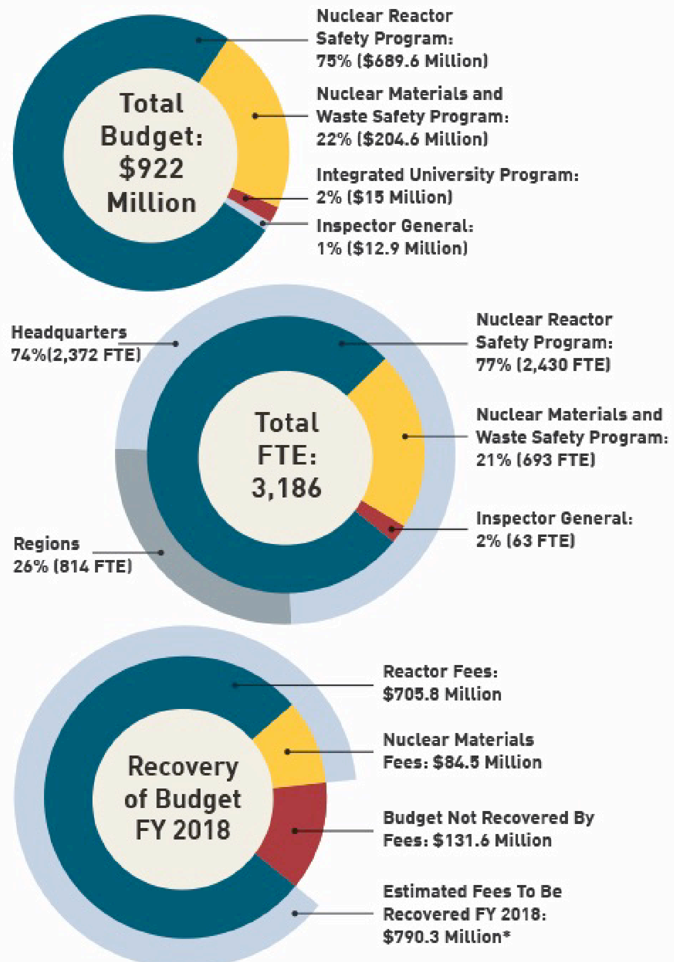
NRC Total Authority, FYs 2008–2018



Note: Dollars are rounded to the nearest million.

As of July 2018

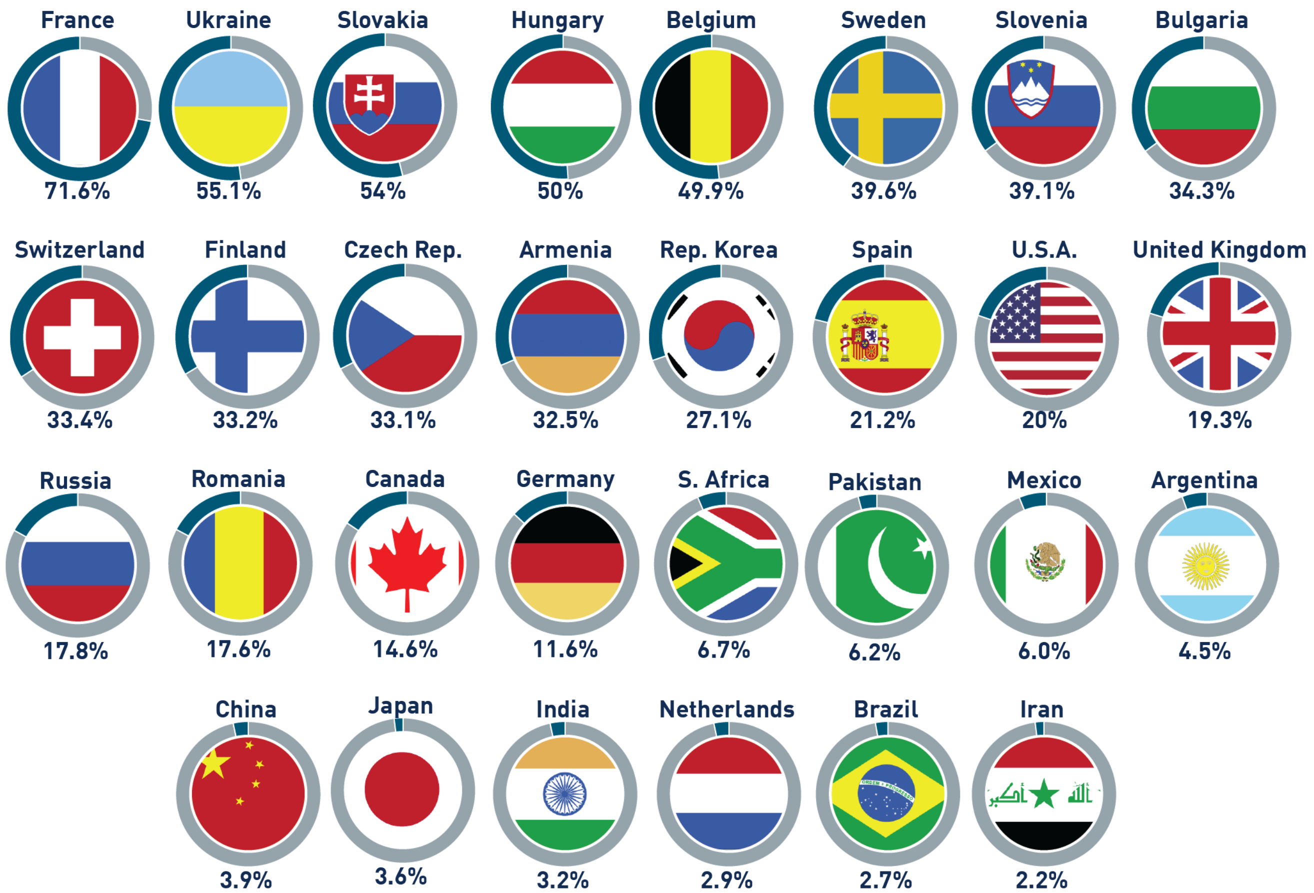
NRC FY 2018 Distribution of Enacted Budget Authority; Recovery of NRC Budget



* Recovered fees do not include the use of prior year carryover where fees were previously collected.
Notes: The NRC incorporates corporate and administrative costs proportionately within programs. Numbers are rounded. Enacted budget for FY 2018.

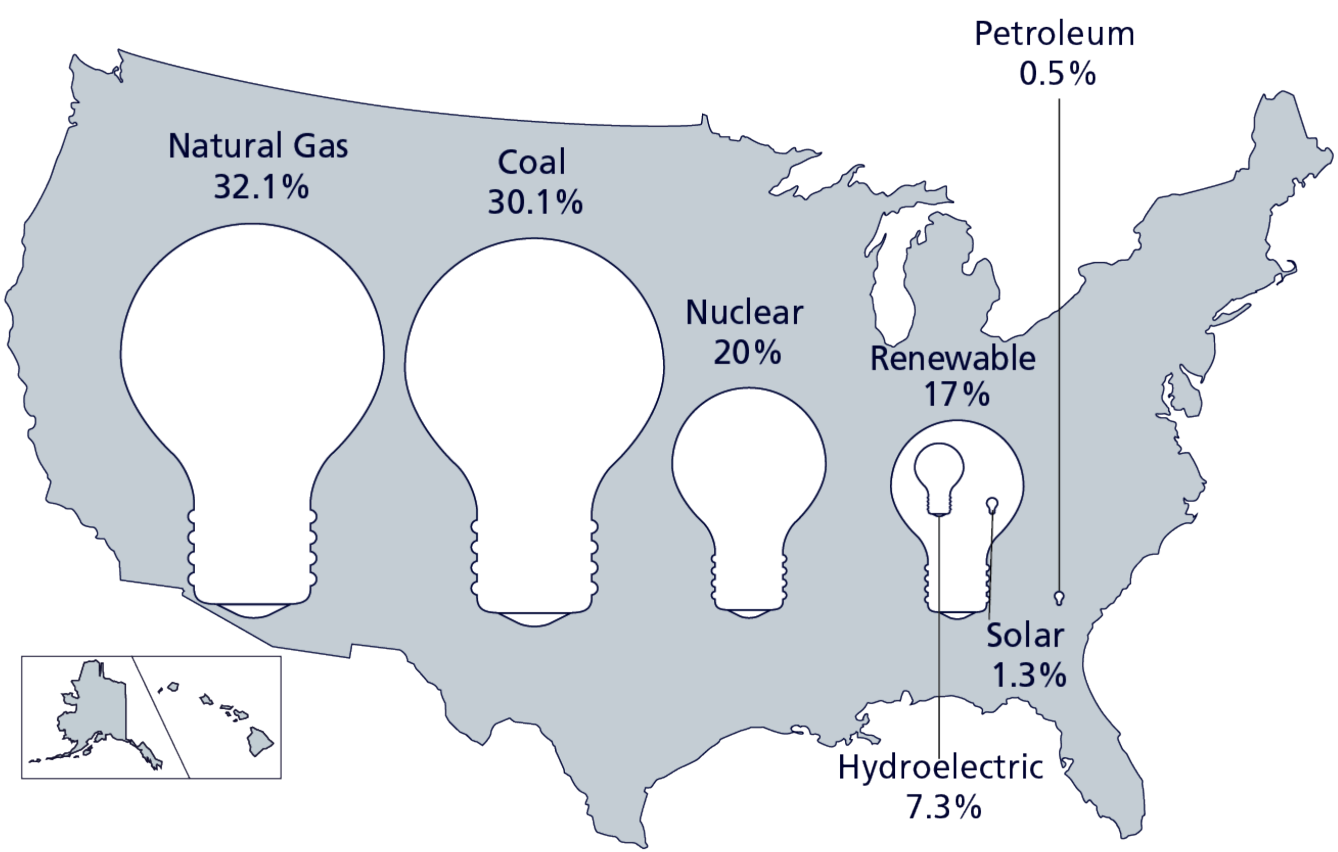
As of July 2018

Nuclear Share of Electricity Generated by Country



As of July 2018

U.S.Gross Electric Generation by Energy Source, 2017



Note: Figures are rounded.
Source: DOE/EIA, June 22, 2018 , *https://www.eia.gov* - Table 7.2A Electricity Net Generation: Total (All Sectors)

As of July 2018

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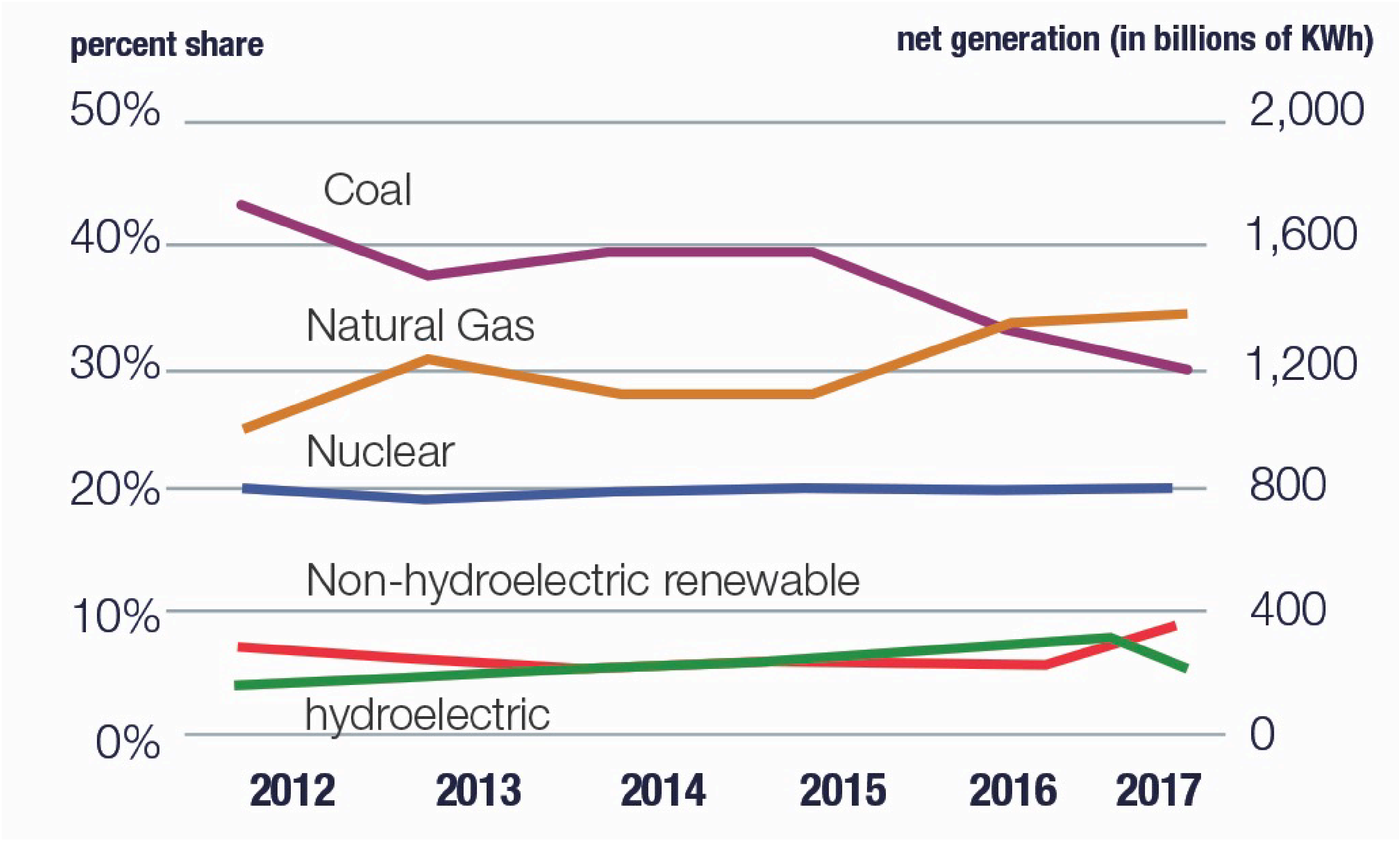
United States Nuclear Regulatory Commission
Protecting People and the Environment

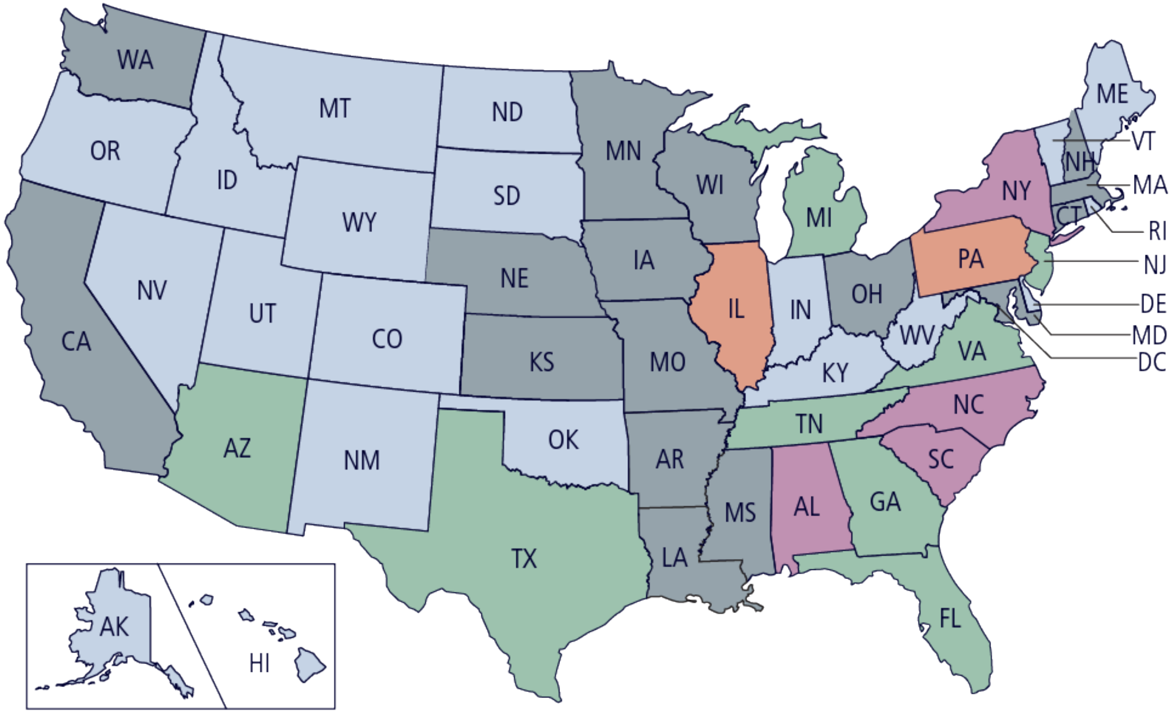
U.S. Electric Share and Generation by Energy Source, 2012–2017



Note: Figures are rounded.
Source: DOE/EIA, June 22, 2018 , *https://www.eia.gov* - Table 7.2A Electricity Net Generation: Total (All Sectors)

As of July 2018

Gross Electricity Generated in Each State by Nuclear Power



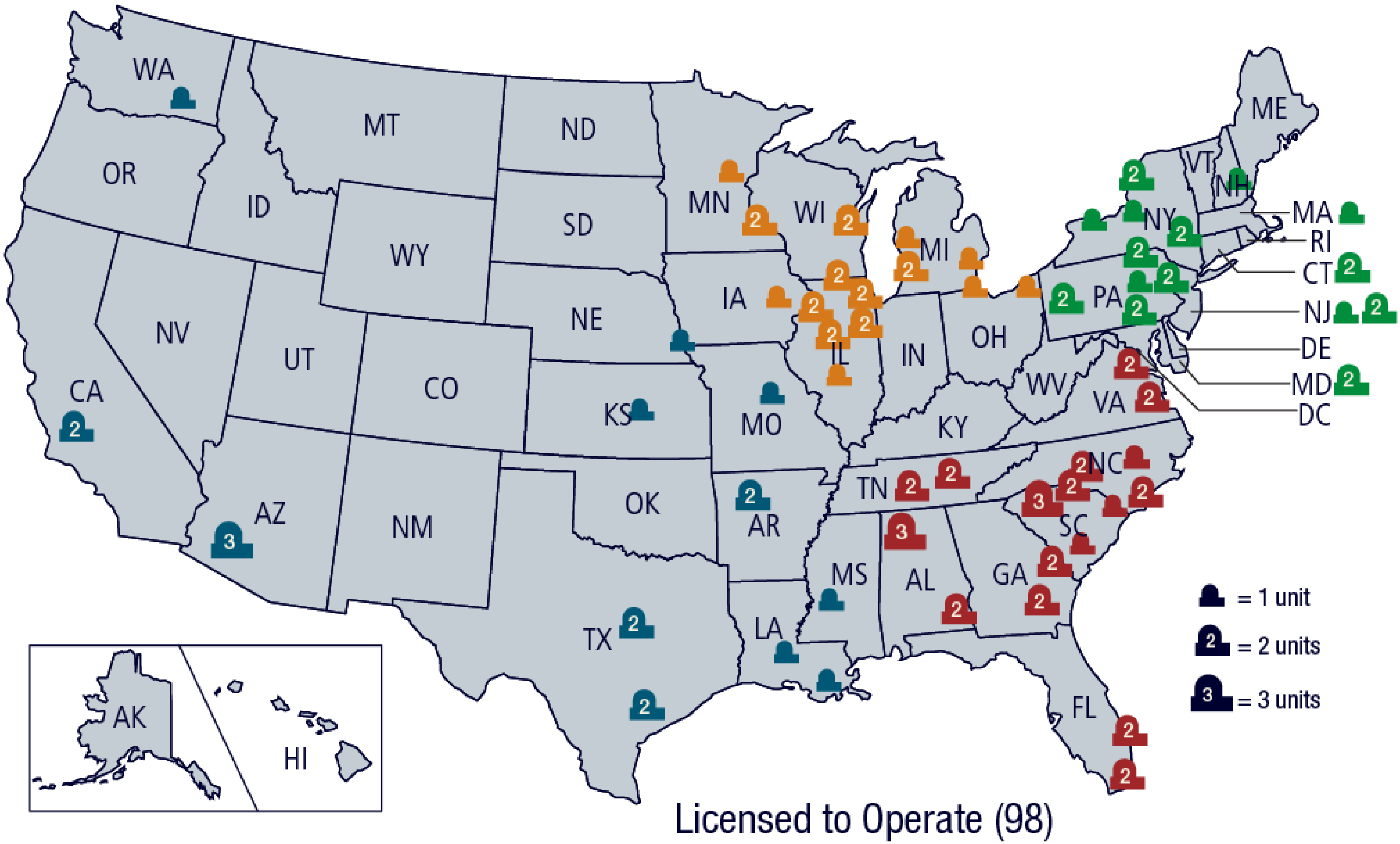
Total Nuclear Power Generated (in thousand megawatt-hours)

None	< less than 20,000	20,001 to 40,000	40,001 to 60,000	> more than 60,001+
20 States	16 States	8 States	4 States	2 States

Note: *U.S. Territories not pictured. American Samoa, Guam, Northern Mariana Islands, Puerto Rico, U.S. Virgin Islands, and Minor Outlying Islands do not generate nuclear power.

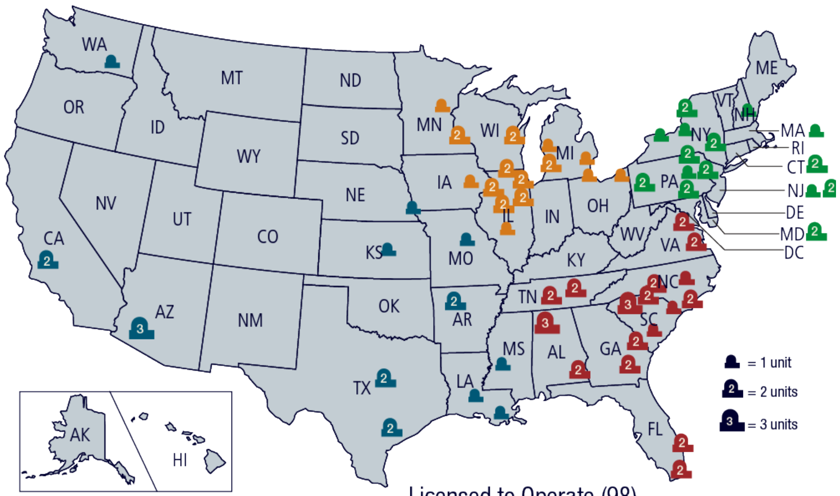
As of July 2018

U.S. Operating Commercial Nuclear Power Reactors



As of Sept. 2018

U.S. Operating Commercial Nuclear Power Reactors



Licensed to Operate (98)

REGION I

CONNECTICUT
- Millstone 2 and 3

MARYLAND
- Calvert Cliffs 1 and 2

MASSACHUSETTS
- Pilgrim

NEW HAMPSHIRE
- Seabrook

NEW JERSEY
- Hope Creek
- Salem 1 and 2

NEW YORK
- FitzPatrick
- Ginna
- Indian Point 2 and 3
- Nine Mile Point 1 and 2

PENNSYLVANIA
- Beaver Valley 1 and 2
- Limerick 1 and 2
- Peach Bottom 2 and 3
- Susquehanna 1 and 2
- Three Mile Island 1

REGION II

ALABAMA
- Browns Ferry 1, 2, and 3
- Farley 1 and 2

FLORIDA
- St. Lucie 1 and 2
- Turkey Point 3 and 4

GEORGIA
- Edwin I. Hatch 1 and 2
- Vogtle 1 and 2

NORTH CAROLINA
- Brunswick 1 and 2
- McGuire 1 and 2
- Harris 1

SOUTH CAROLINA
- Catawba 1 and 2
- Oconee 1, 2, and 3
- Robinson 2
- Summer

TENNESSEE
- Sequoyah 1 and 2
- Watts Bar 1 and 2

VIRGINIA
- North Anna 1 and 2
- Surry 1 and 2

REGION III

ILLINOIS
- Braidwood 1 and 2
- Byron 1 and 2
- Clinton
- Dresden 2 and 3
- LaSalle 1 and 2
- Quad Cities 1 and 2

IOWA
- Duane Arnold

MICHIGAN
- Cook 1 and 2
- Fermi 2
- Palisades

MINNESOTA
- Monticello
- Prairie Island 1 and 2

OHIO
- Davis-Besse
- Perry

WISCONSIN
- Point Beach 1 and 2

REGION IV

ARKANSAS
- Arkansas Nuclear 1 and

ARIZONA
- Palo Verde 1, 2, and 3

CALIFORNIA
- Diablo Canyon 1 and 2

KANSAS
- Wolf Creek 1

LOUISIANA
- River Bend 1
- Waterford 3

MISSISSIPPI
- Grand Gulf

MISSOURI
- Callaway

NEBRASKA
- Cooper

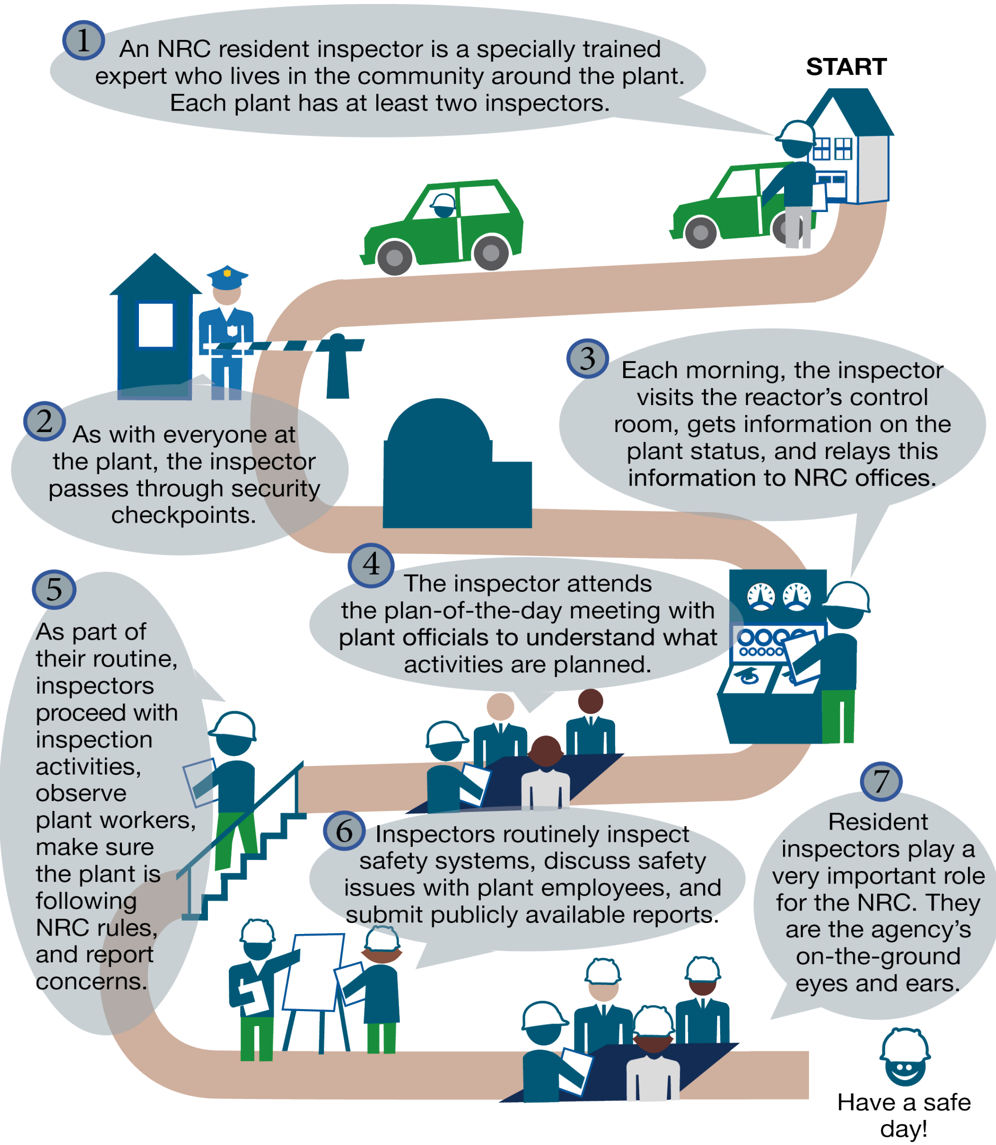
TEXAS
- Comanche Peak 1 and 2
- South Texas Project 1 and 2

WASHINGTON
- Columbia

As of Sept. 2018

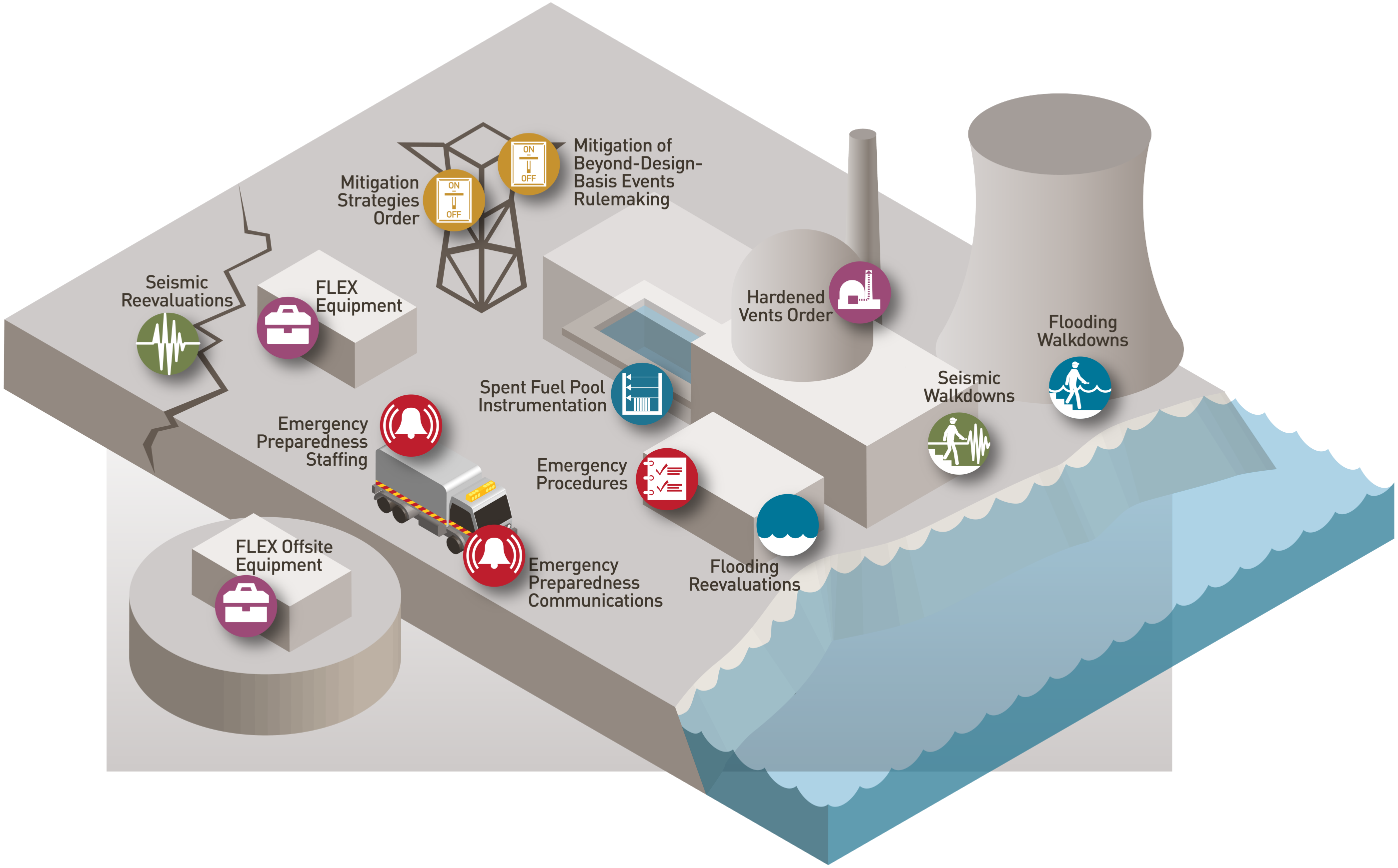
U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Day in the Life of an NRC Resident Inspector



As of July 2018

NRC Post-Fukushima Safety Enhancements



As of July 2018

Reactor Oversight Action Matrix Performance Indicators

Performance Indicators

GREEN | WHITE | YELLOW | RED

INCREASING SAFETY SIGNIFICANCE →

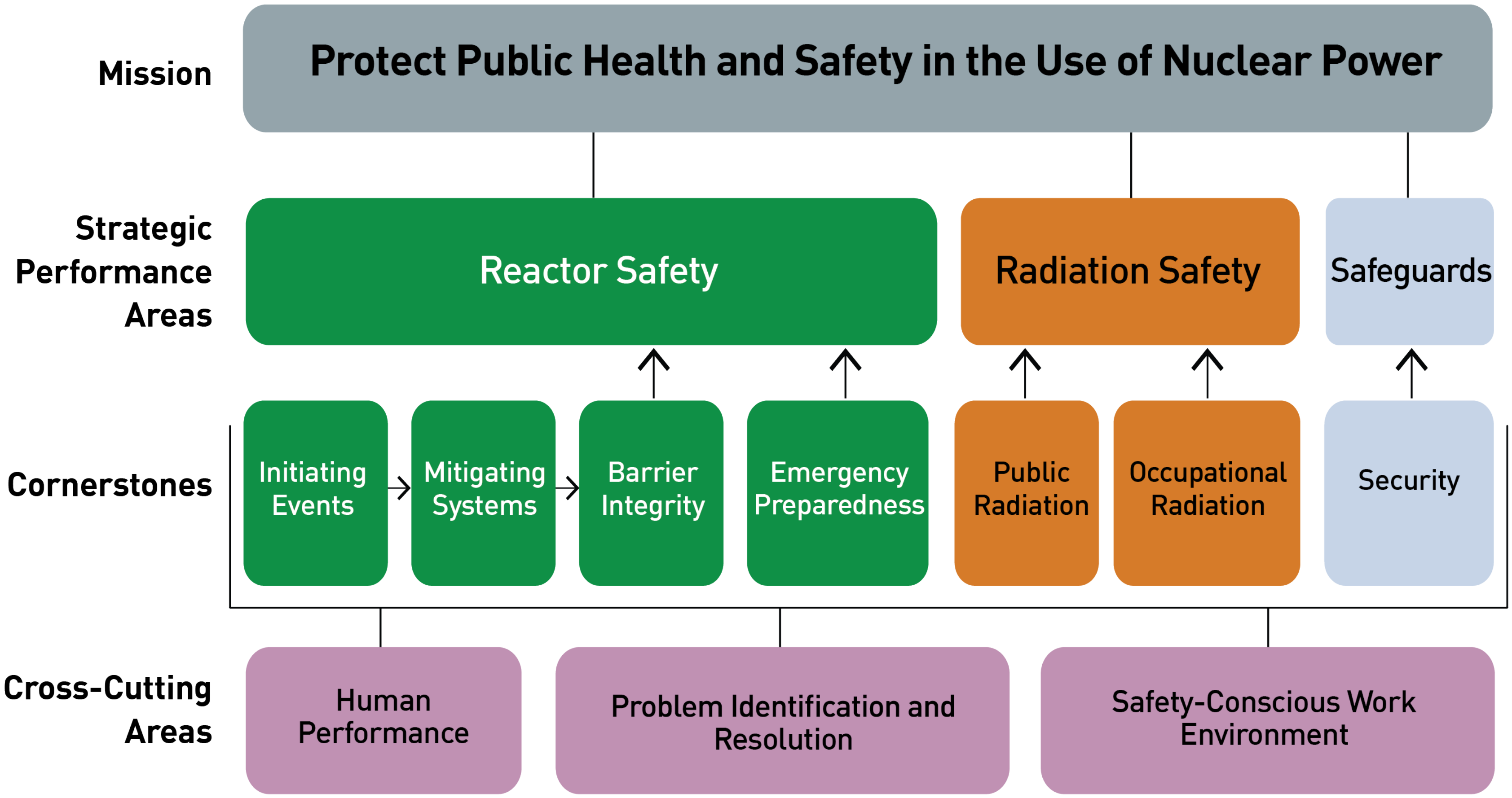
Inspection Findings

GREEN | WHITE | YELLOW | RED

INCREASING SAFETY SIGNIFICANCE →

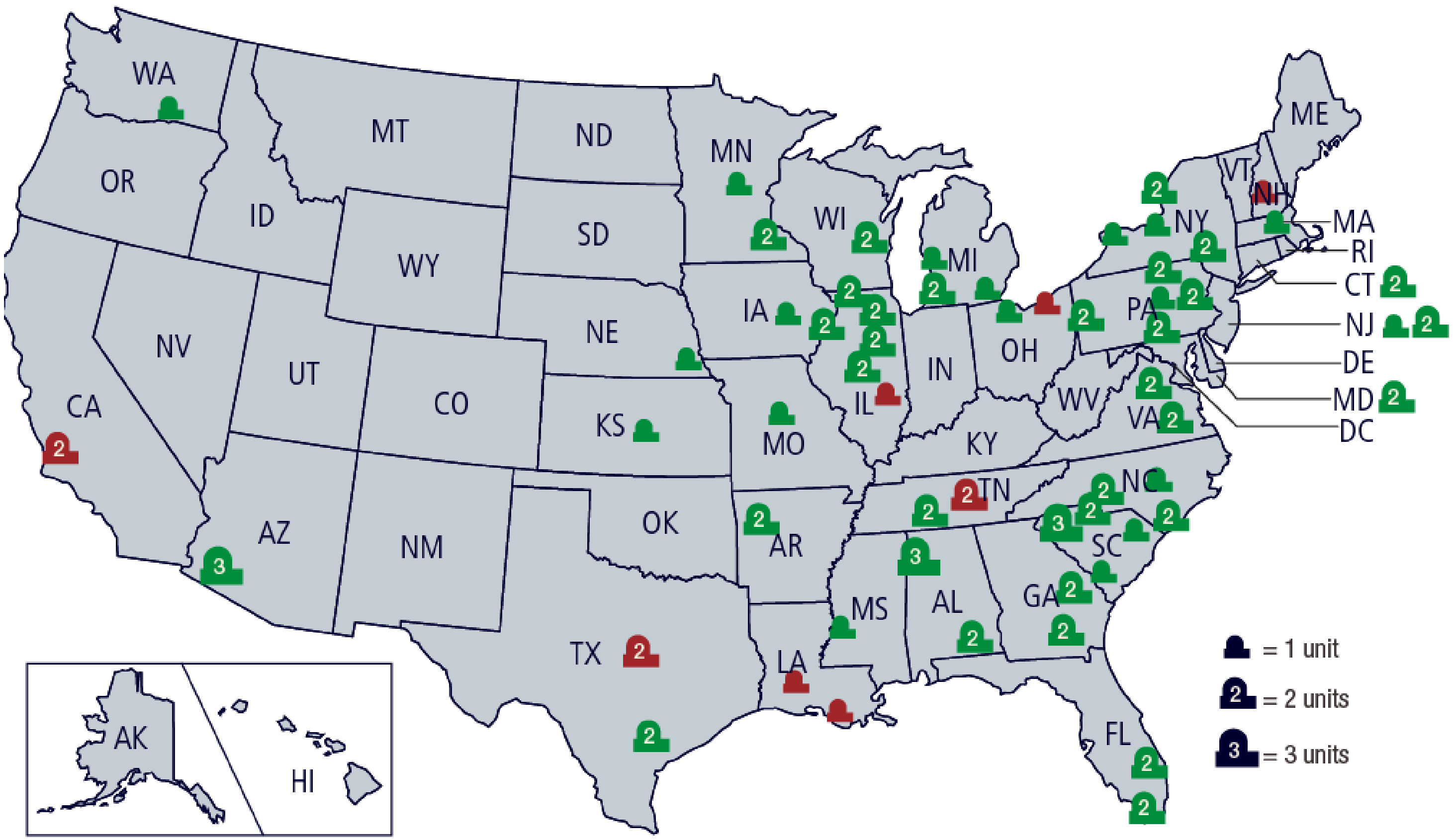
As of July 2018

Reactor Oversight Framework



As of July 2018

License Renewals Granted for Operating Nuclear Power Reactors



Licensed to Operate (98)

Original License (11) License Renewal Granted (87)

U.S.NRC
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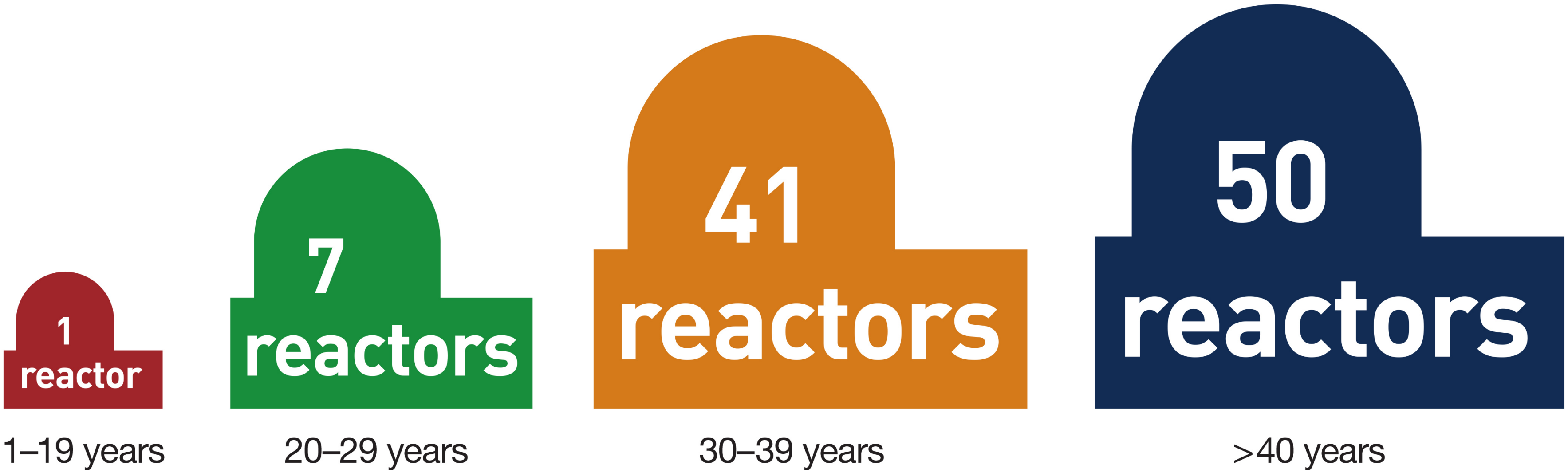
Protecting People and the Environment
Data as of September 2018

Note: The NRC has issued a total of 91 license renewals; four of these units have permanently shut down. Data are as of September 2018. For the most recent information, go to the Dataset Index Web page at https://www.nrc.gov/reading-rm/doc-collections/datasets/.

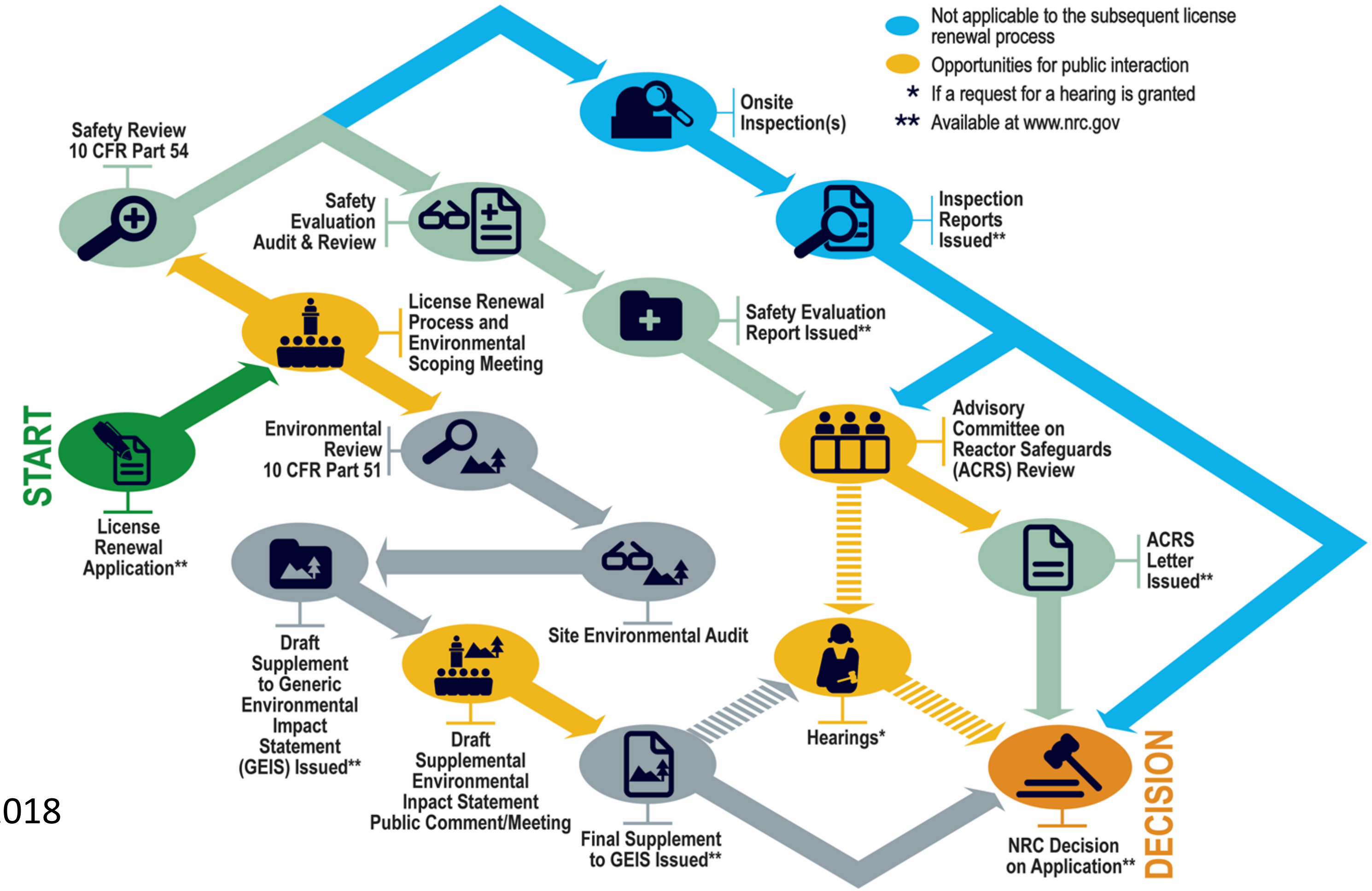
U.S. Commercial Nuclear Power Reactors–Years of Operation by the End of 2018



Note: Ages have been rounded up to the end of the year.
Source: U.S. Nuclear Regulatory Commission

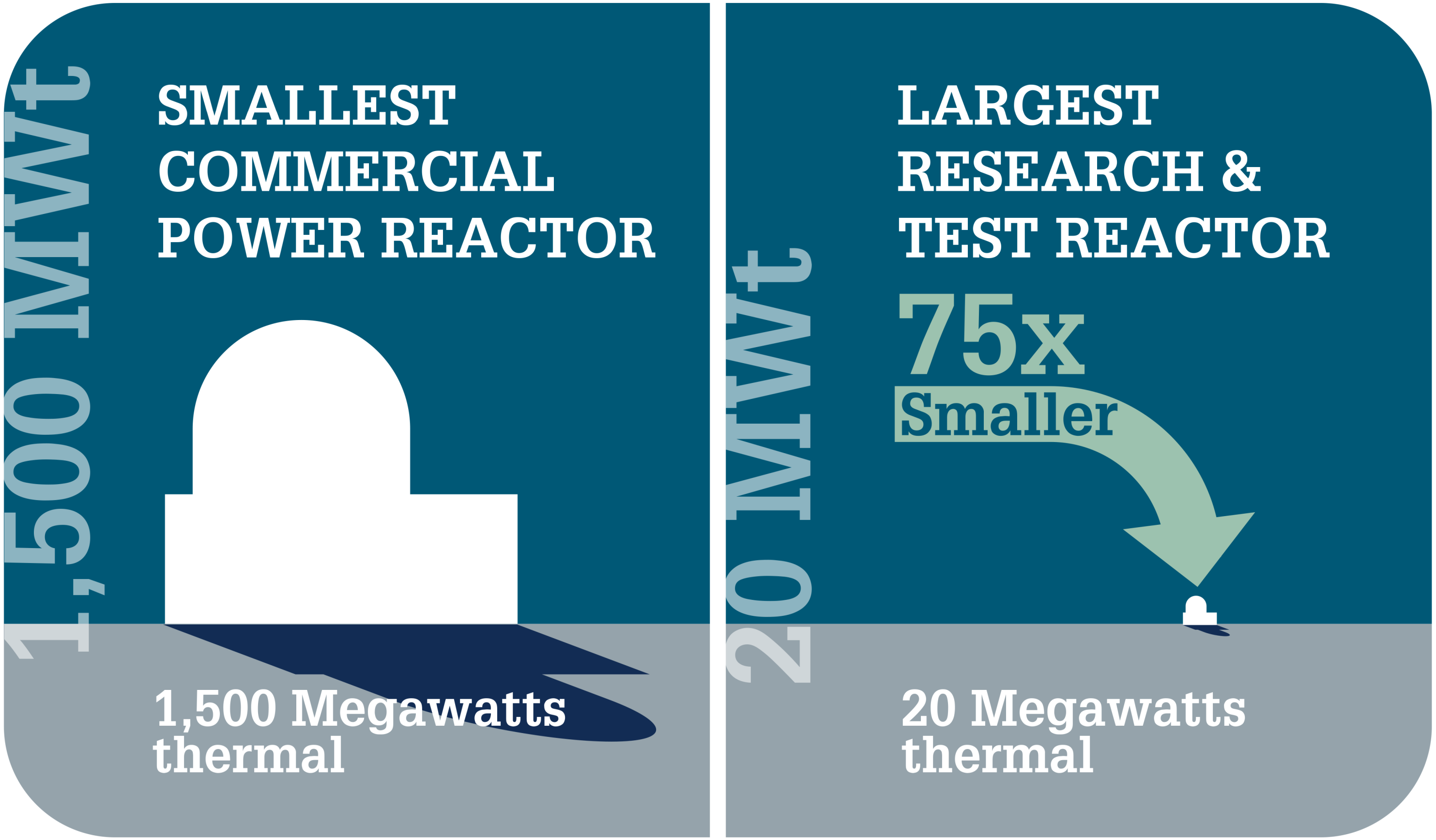
As of July 2018

License Renewal Process



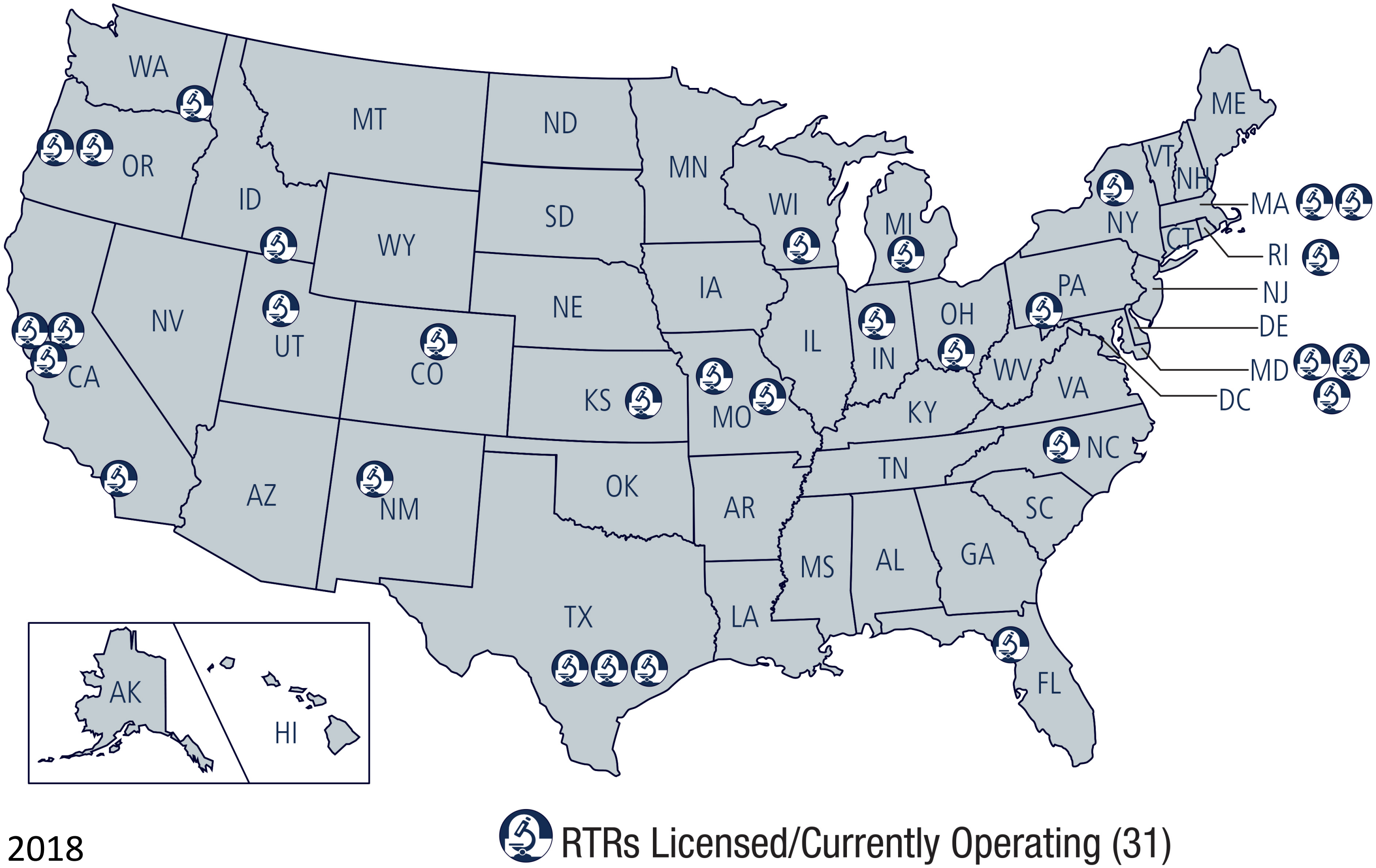
As of July 2018

Size Comparison of Commercial and Research Reactors



As of July 2018

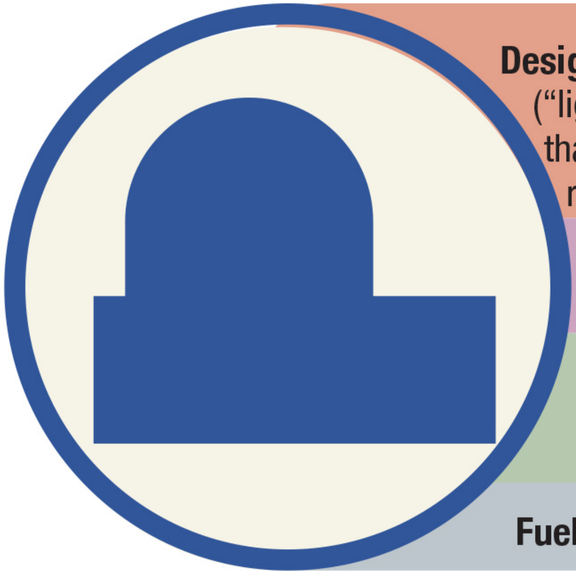
U.S. Nuclear Research and Test Reactors



As of July 2018

The Different NRC Classification for Types of Reactors

Operating Reactors



Design: The U.S. fleet consists mainly of large reactors that use regular water ("light" water, as opposed to "heavy" water that has a different type of hydrogen than commonly found in nature) for both cooling the core and facilitating the nuclear reaction.

Capacity: The generation base load of these plants is 1,500 MWt (495 MWe) or higher.

Safety: These reactors have "active" safety systems powered by alternating current (ac) and require an operator to shut down.

Fuel: These reactors require enriched uranium.

As of July 2018

The Different NRC Classification for Types of Reactors

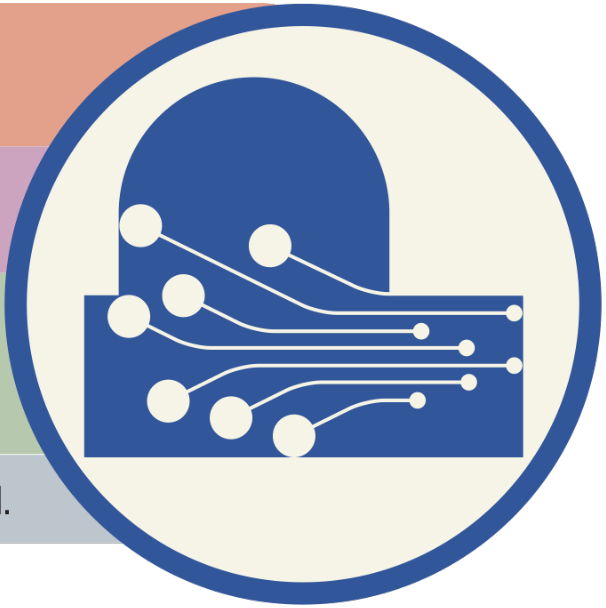
Advanced Reactors

Design: Advanced reactors are a new generation of nonlight-water reactors. They use coolants including molten salts, liquid metals, and even gases such as helium.

Capacity: These plants range in power from very small reactors to a power level comparable to existing operating reactors.

Safety: These reactors are expected to provide enhanced margins of safety and use simplified, inherent, and passive means to ensure safety. They may not require an operator to shut down.

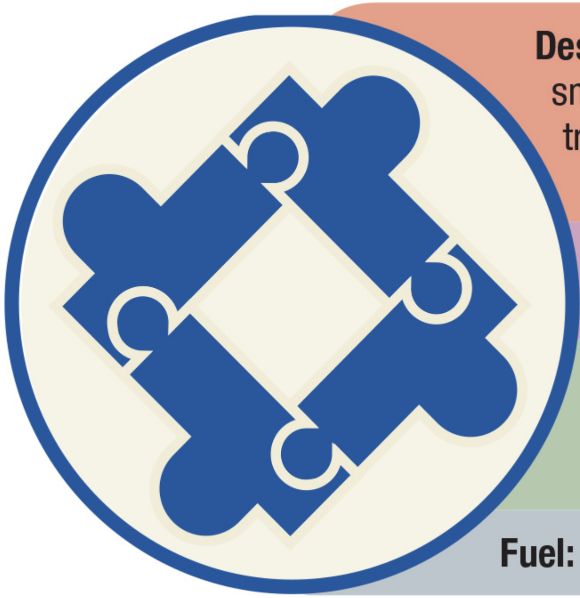
Fuel: These reactors could use enriched uranium, thorium, or used nuclear fuel.



As of July 2018

The Different NRC Classification for Types of Reactors

Small Modular Reactors



Design: Small modular reactors (SMRs) are similar to light-water reactors but are smaller, compact designs. These factory-fabricated reactors can be transported by truck or rail to a nuclear power site. Additional SMRs can be installed on site to scale or meet increased energy needs.

Capacity: These reactors are about one-third the size of typical reactors with generation base load of 1,000 MWt (300 MWe) or less.

Safety: These reactors can be installed underground, providing more safety and security. They are built with passive safety systems and can be shut down without an operator.

Fuel: These reactors require enriched uranium.

As of July 2018

The Different NRC Classification for Types of Reactors

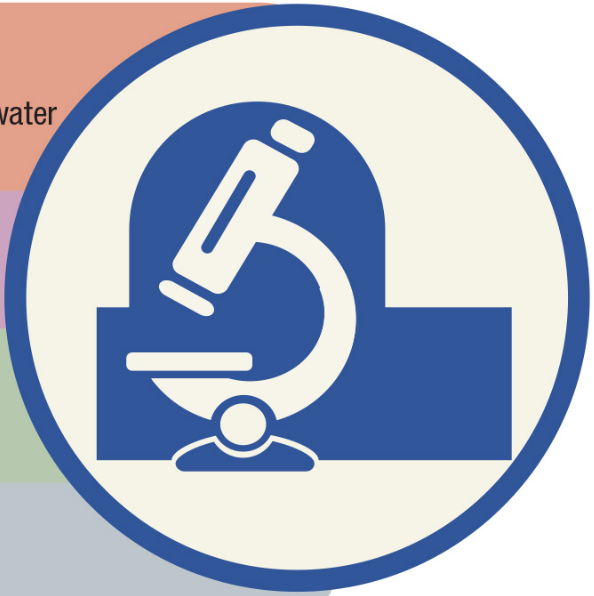
Research and Test Reactors

Design: Research and test reactors—also called "nonpower" reactors—are primarily used for research, training, and development. They are classified by their moderator, the material used to slow down the neutrons, in the nuclear reaction. Typical moderators include water (H_2O), heavy water (D_2O), polyethylene, and graphite.

Capacity: These current licensed facilities range in size from 5 watts (less than a night light) to 20 MWt (equivalent to 20 standard medical X-ray machines).

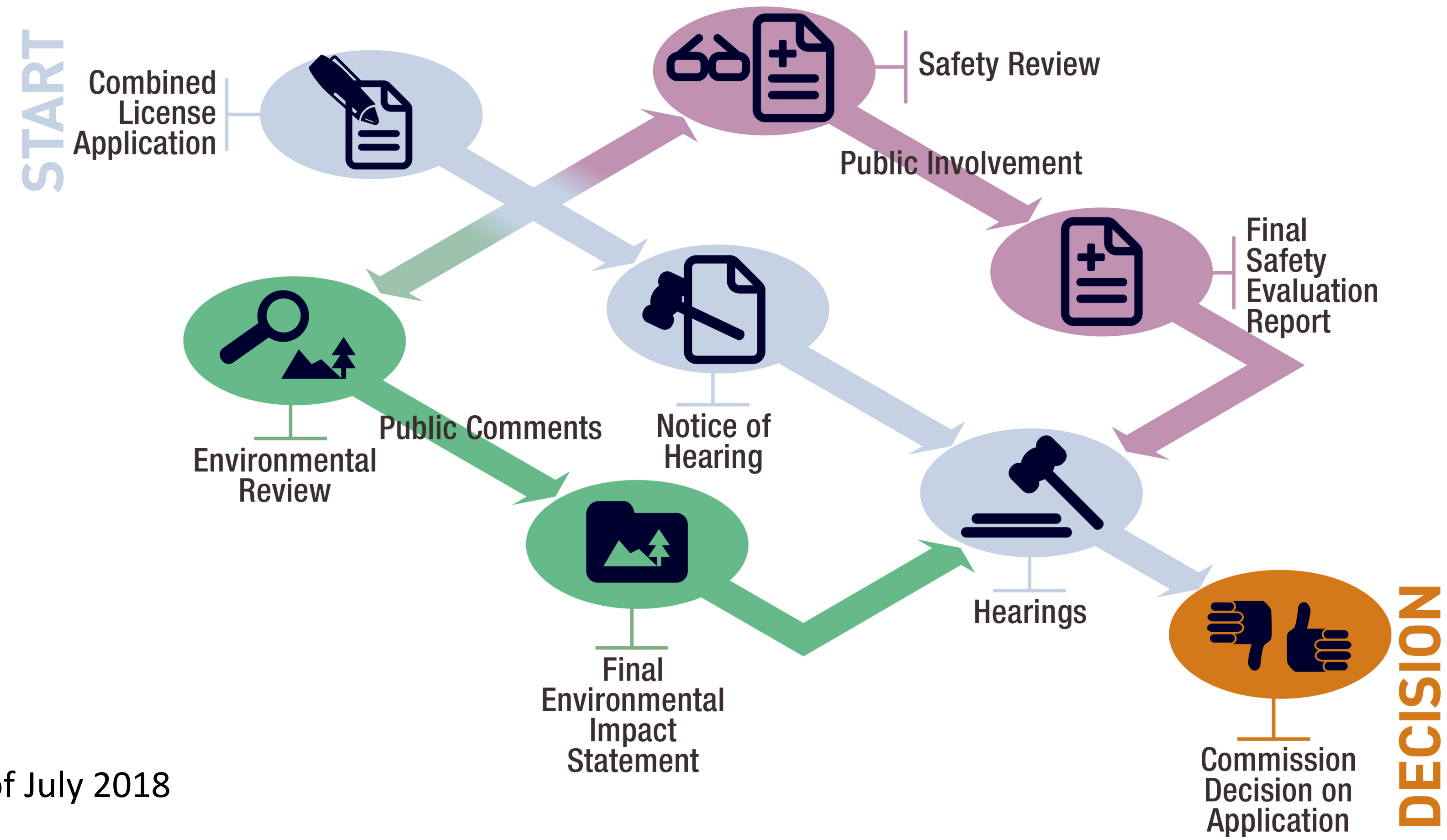
Safety: All NRC-licensed research and test reactors have a built-in safety feature that reduces reactor power during potential accidents before an unacceptable power level or temperature can be reached.

Fuel: Reactors may also be classified by the type of fuel used, such as MTR (plate-type fuel) or TRIGA fuel. TRIGA fuel is unique in that a moderator (hydrogen) is chemically bonded to the fuel.



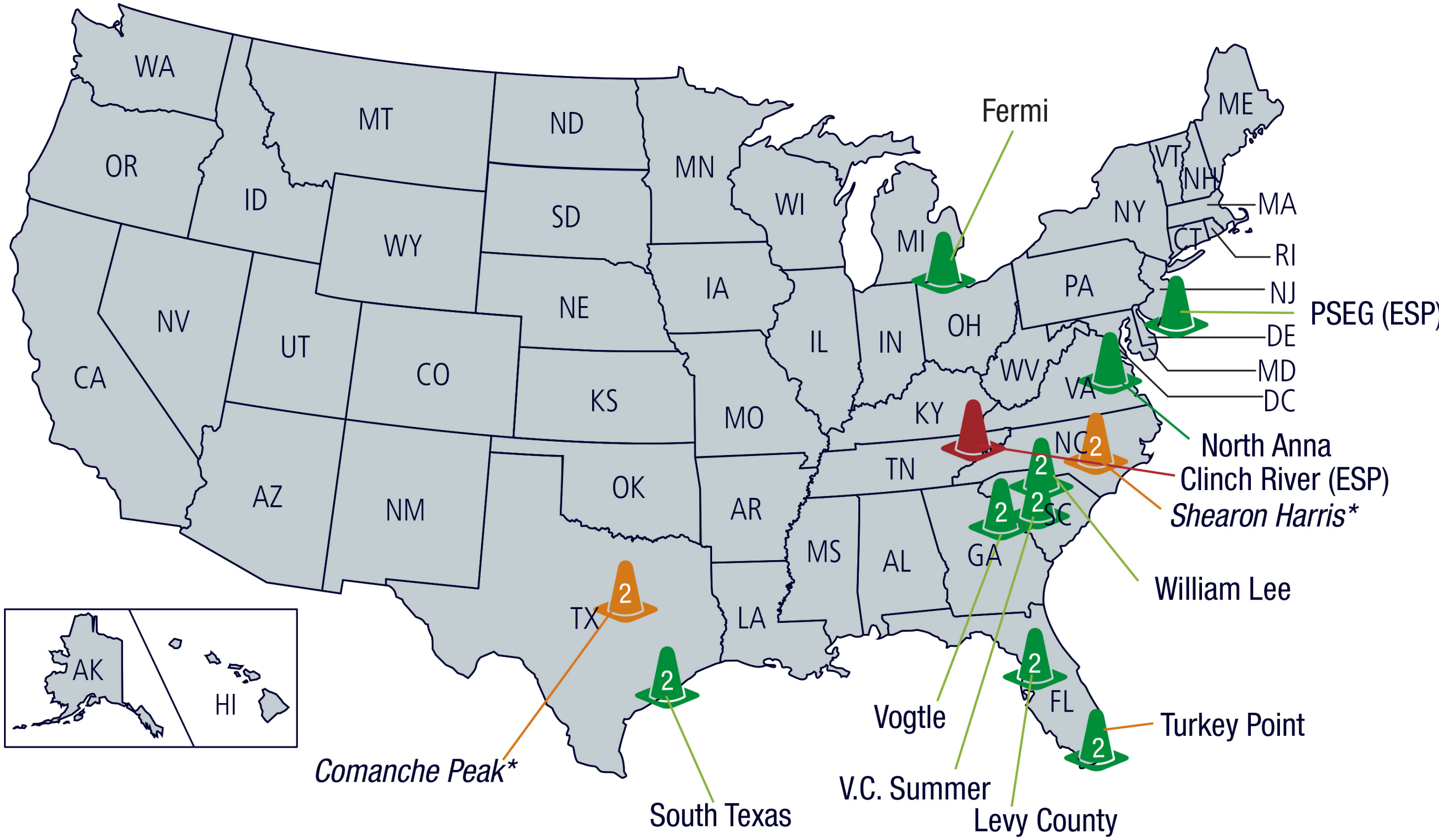
As of July 2018

New Reactor Licensing Process



As of July 2018

Locations of New Nuclear Power Reactor Applications



= A proposed new reactor at or near an existing nuclear plant

= A proposed reactor at a site that has not previously produced nuclear power

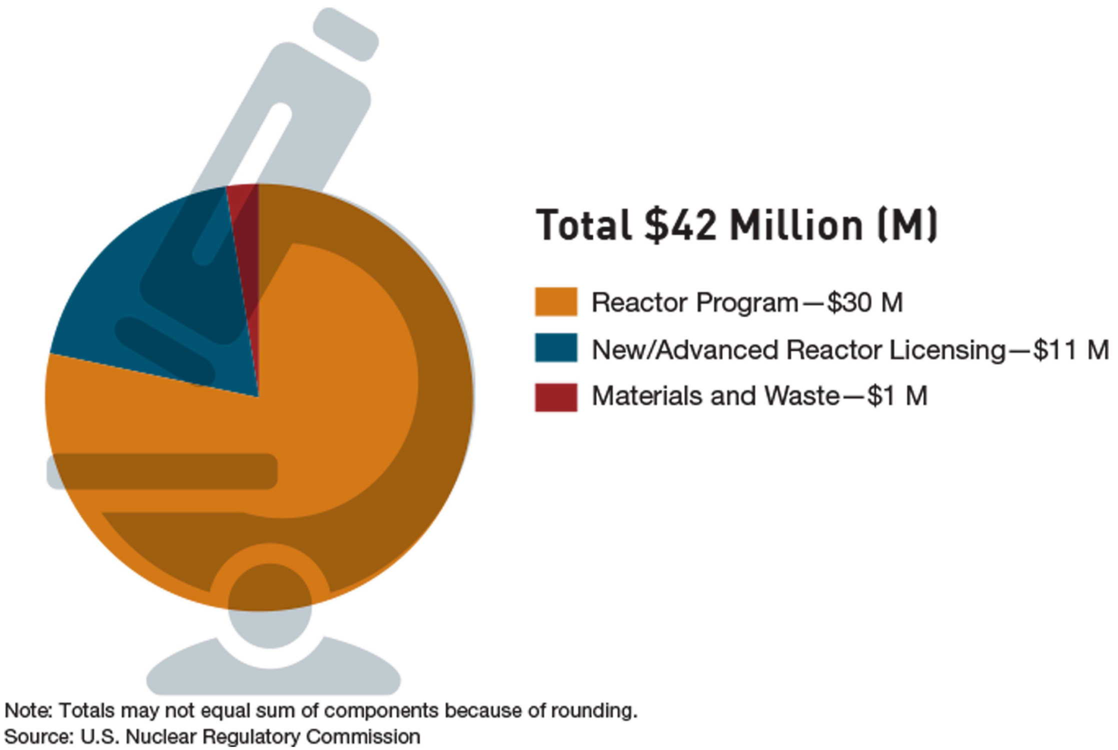
= Approved reactor

= 1 unit

2 = 2 units

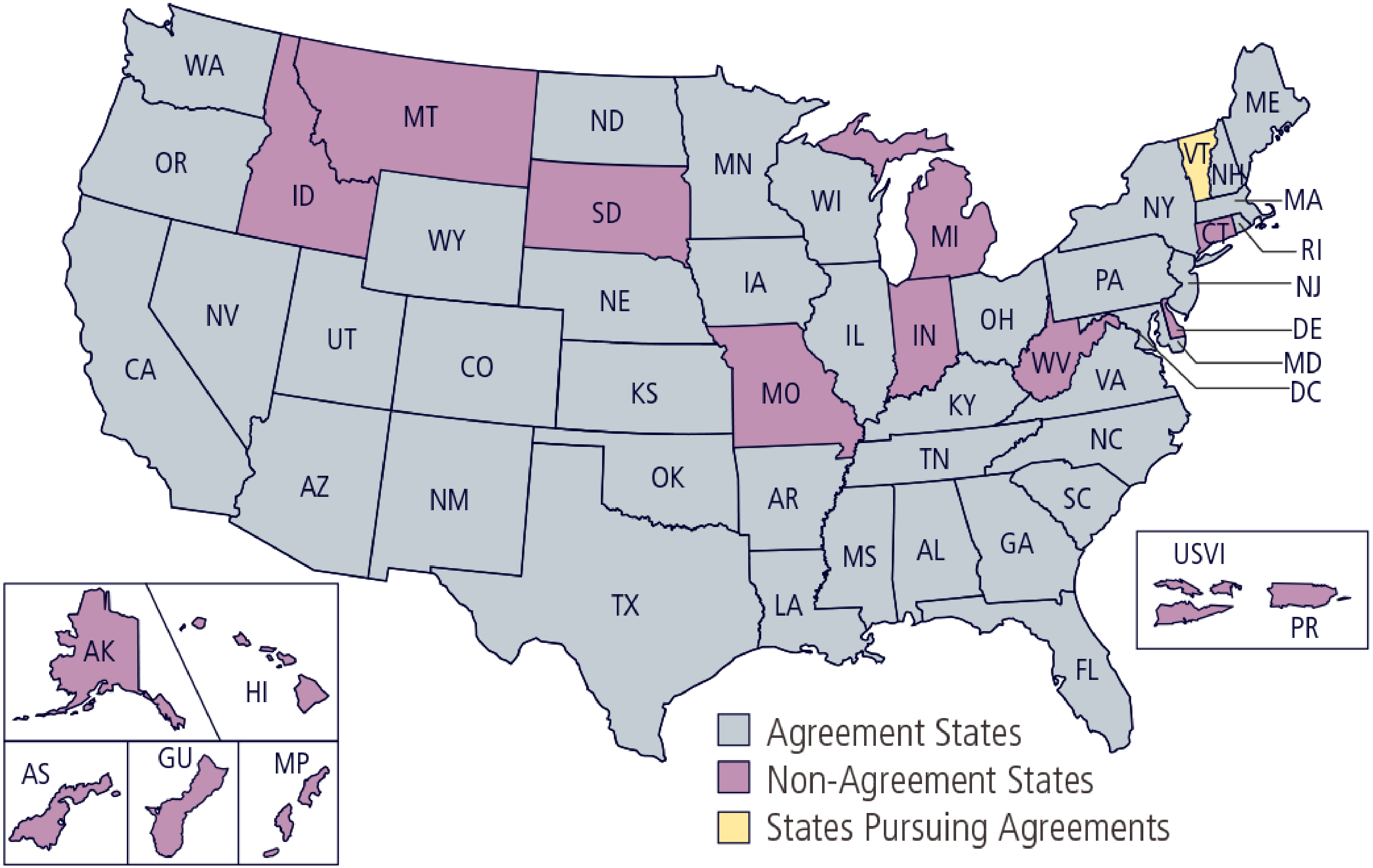
As of July 2018

NRC Research Funding, FY 2018



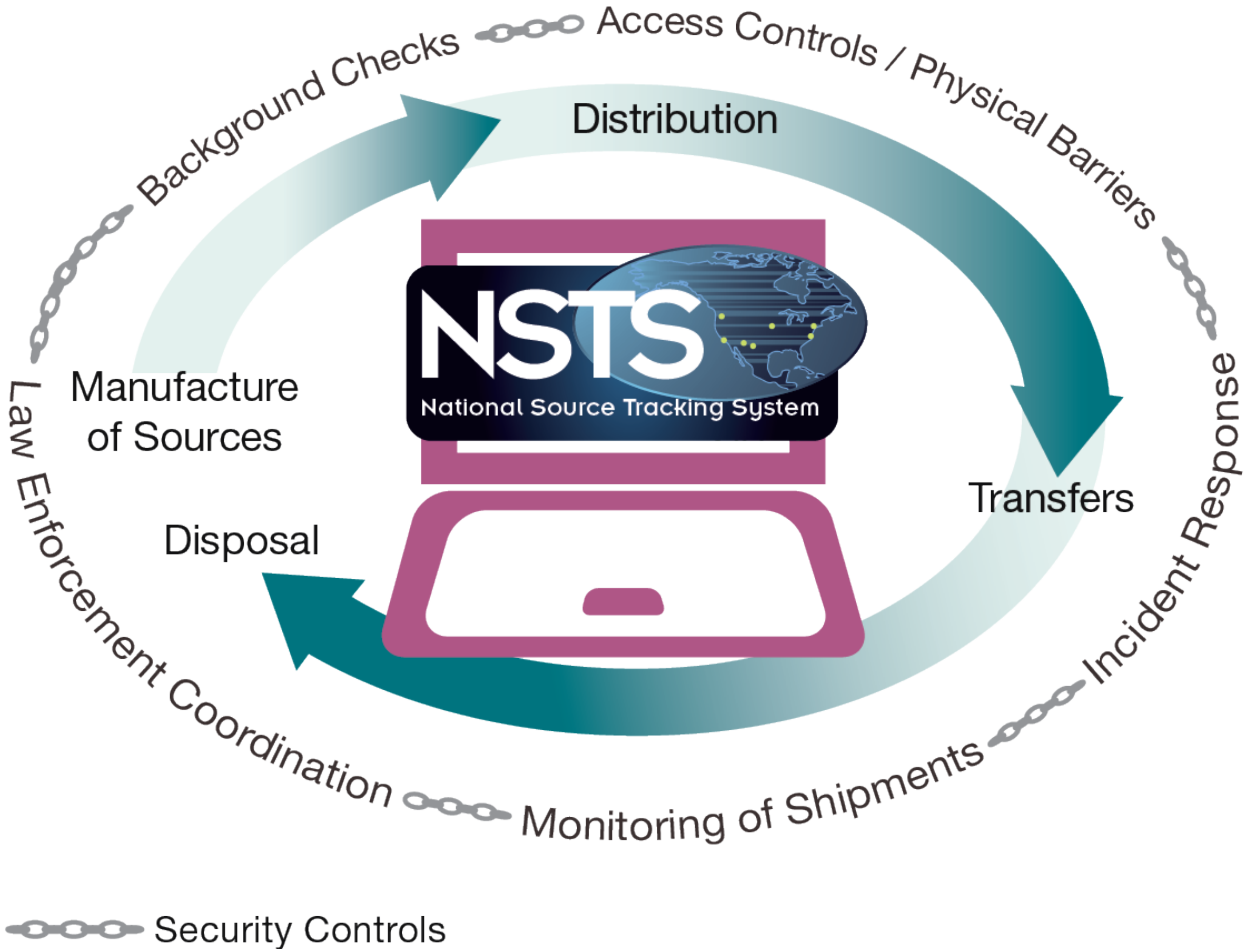
As of July 2018

Agreement States



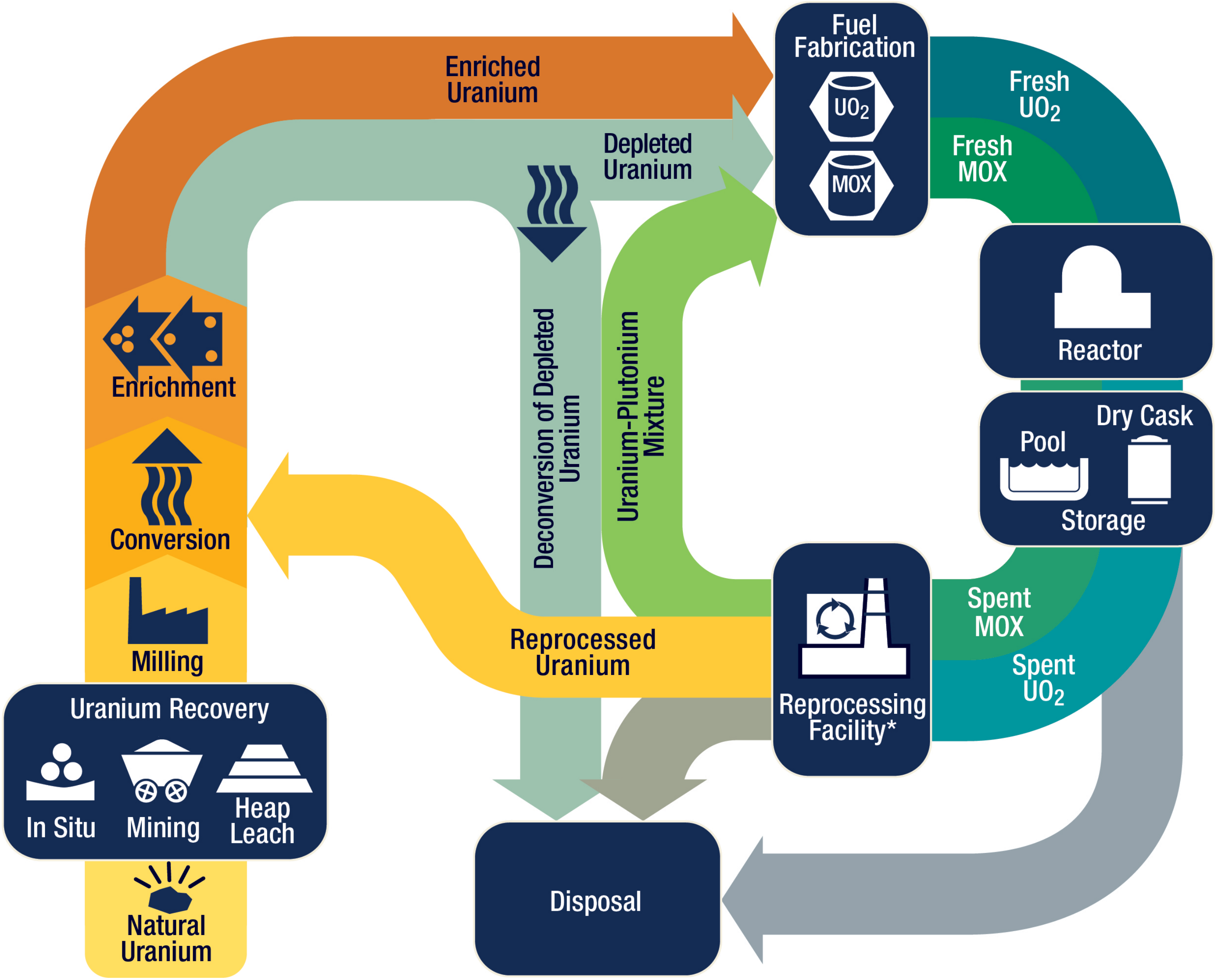
As of Sept. 2018

Life-Cycle Approach to Source Security



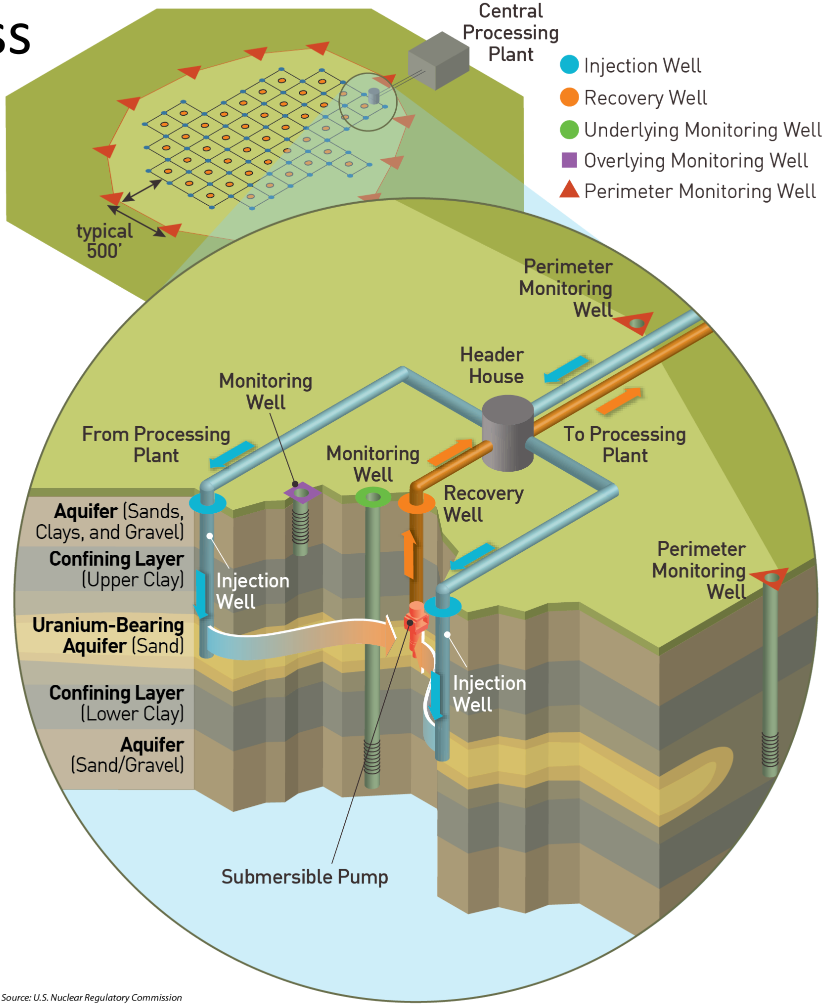
As of July 2018

The Nuclear Fuel Cycle



As of July 2018

The In Situ Uranium Recovery Process



Source: U.S. Nuclear Regulatory Commission

Injection wells ● pump a solution of native ground water, typically mixed with oxygen or hydrogen peroxide and sodium bicarbonate ore carbon dioxide into the aquifer (ground water) containing uranium ore. The solution dissolves the uranium from the deposit in the ground and is then pumped back to the surface through recovery wells ●, all controlled by the header house. From there, the solution is sent to the processing plant. Monitoring wells ● ■ ▲ are checked regularly to ensure the injection solution is not escaping from the wellfield. Confining layers keep ground water from moving from one aquifer to another.

As of July 2018

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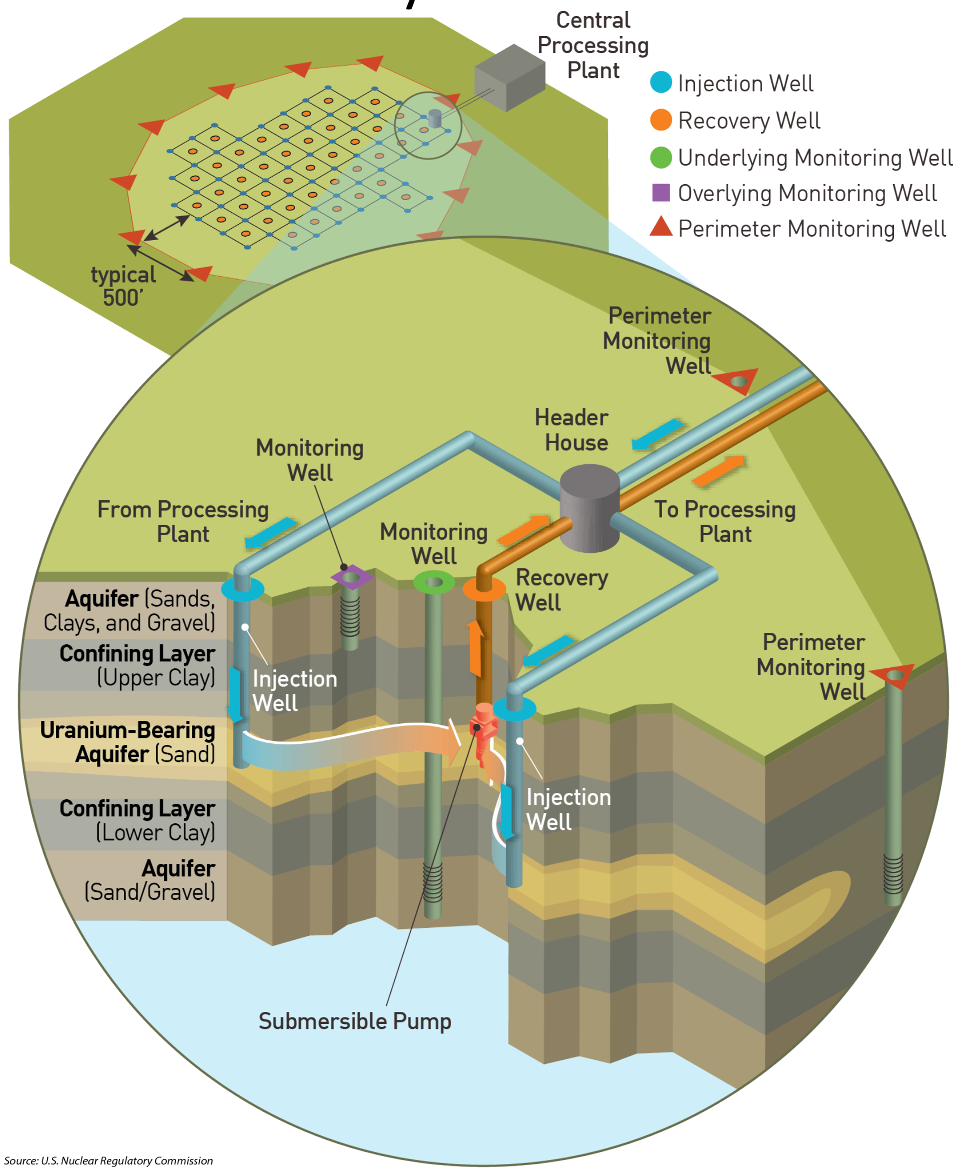
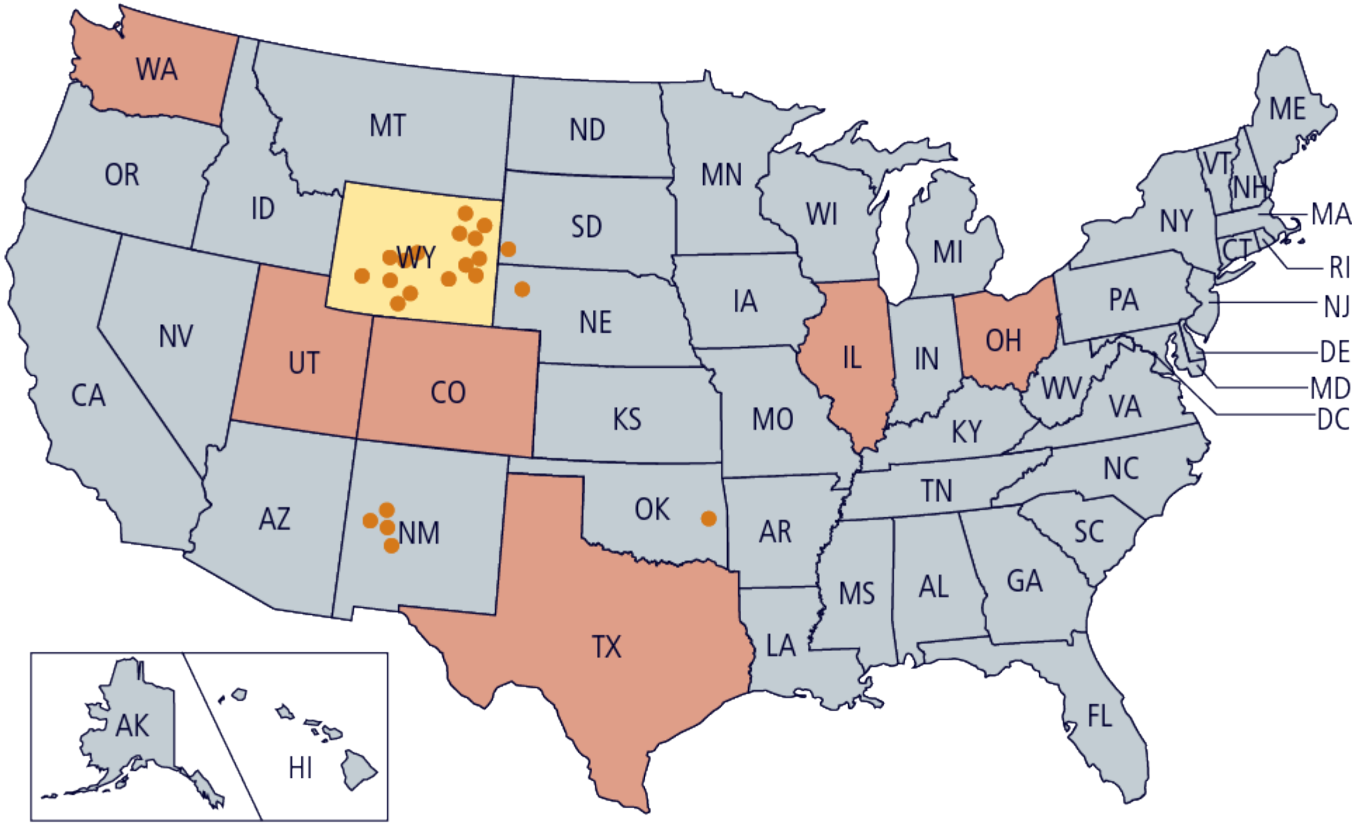
The In Situ Uranium Recovery Process



Source: U.S. Nuclear Regulatory Commission

As of July 2018

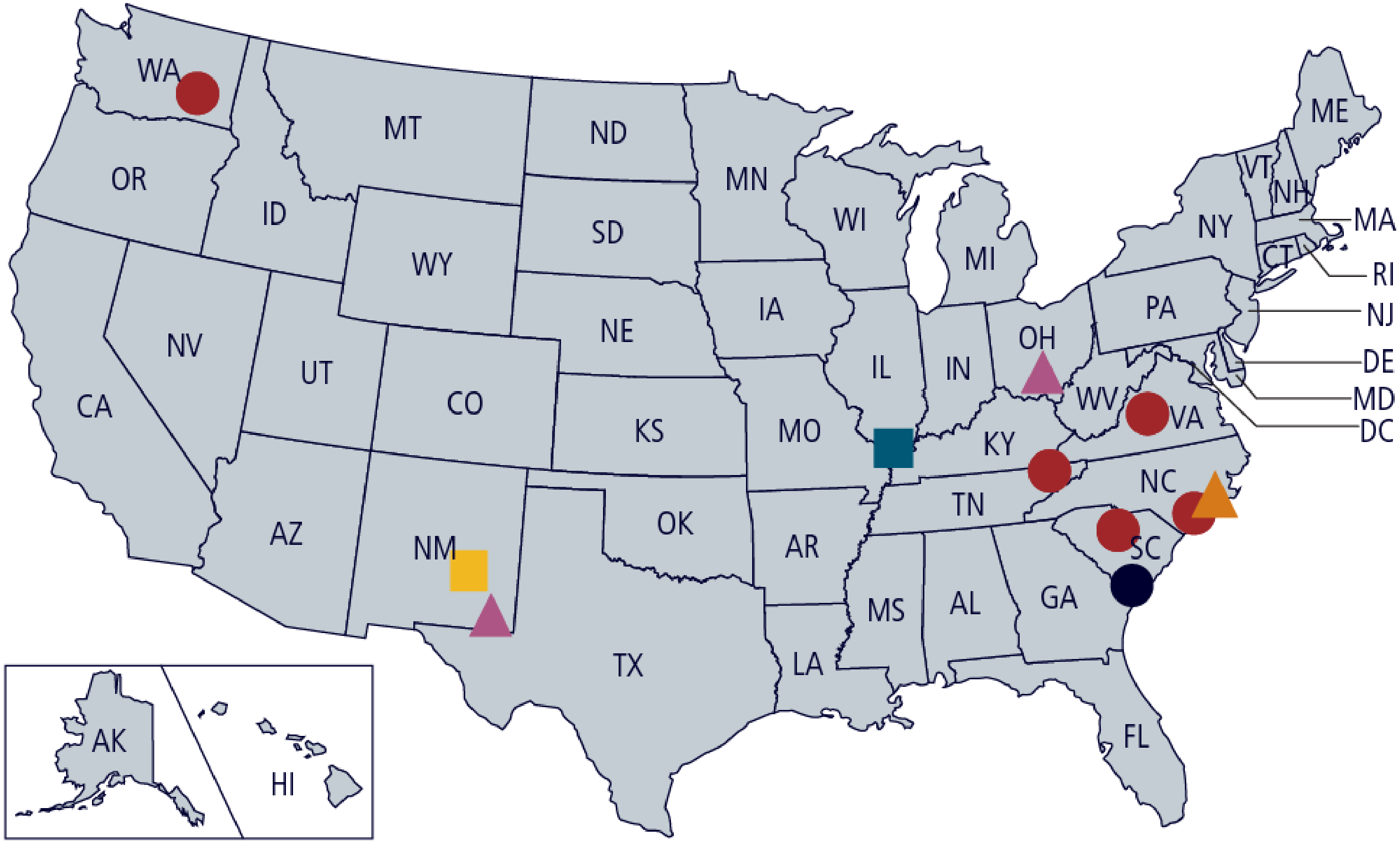
Locations of NRC-Licensed Uranium Recovery Facility Sites



- States with authority to license uranium recovery facility sites
- States where the NRC has retained authority to license uranium recovery facilities
- Final Agreement State application received
- NRC-licensed uranium recovery facility sites (22)

As of July 2018

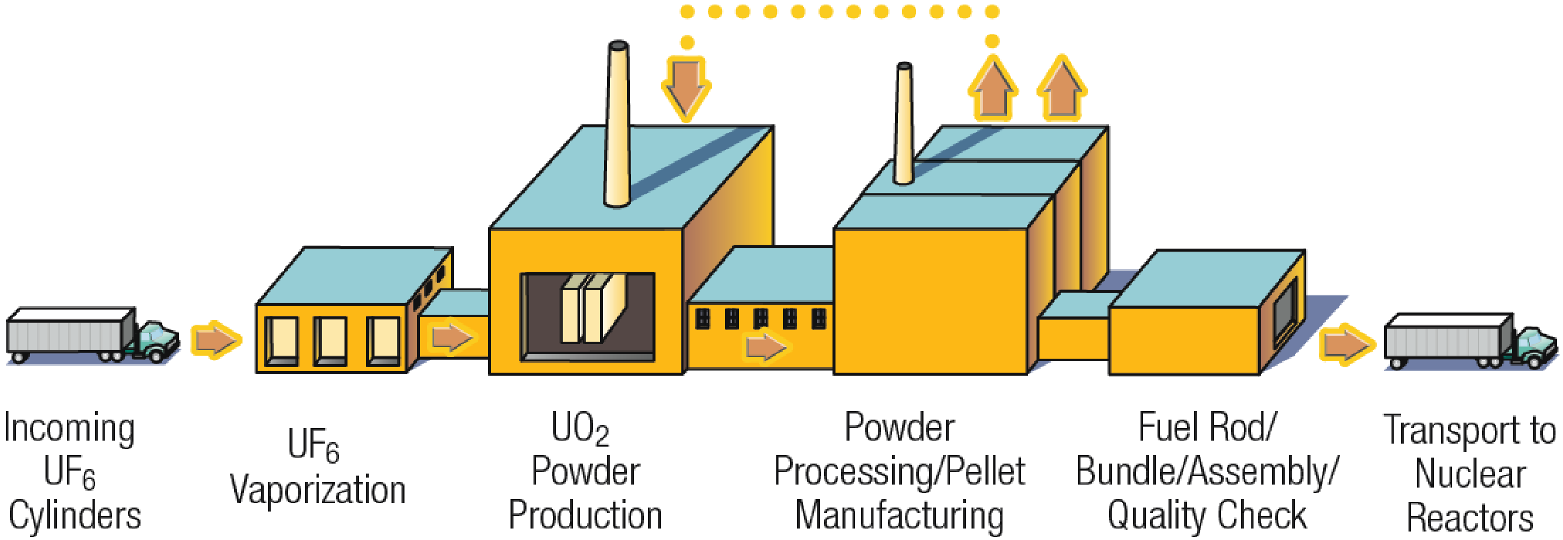
Locations of NRC-Licensed Fuel Cycle Facilities



Uranium Hexafluoride Conversion Facility (1)
Uranium Fuel Fabrication Facility (5)
Mixed-Oxide Fuel Fabrication Facility (1)
Gas Centrifuge Uranium Enrichment Facility (2)
Uranium Enrichment Laser Separation Facility (1)
Depleted Uranium Deconversion Facility (1)

As of July 2018

Simplified Fuel Fabrication Process



Fabrication of commercial light-water reactor fuel consists of the following three basic steps:

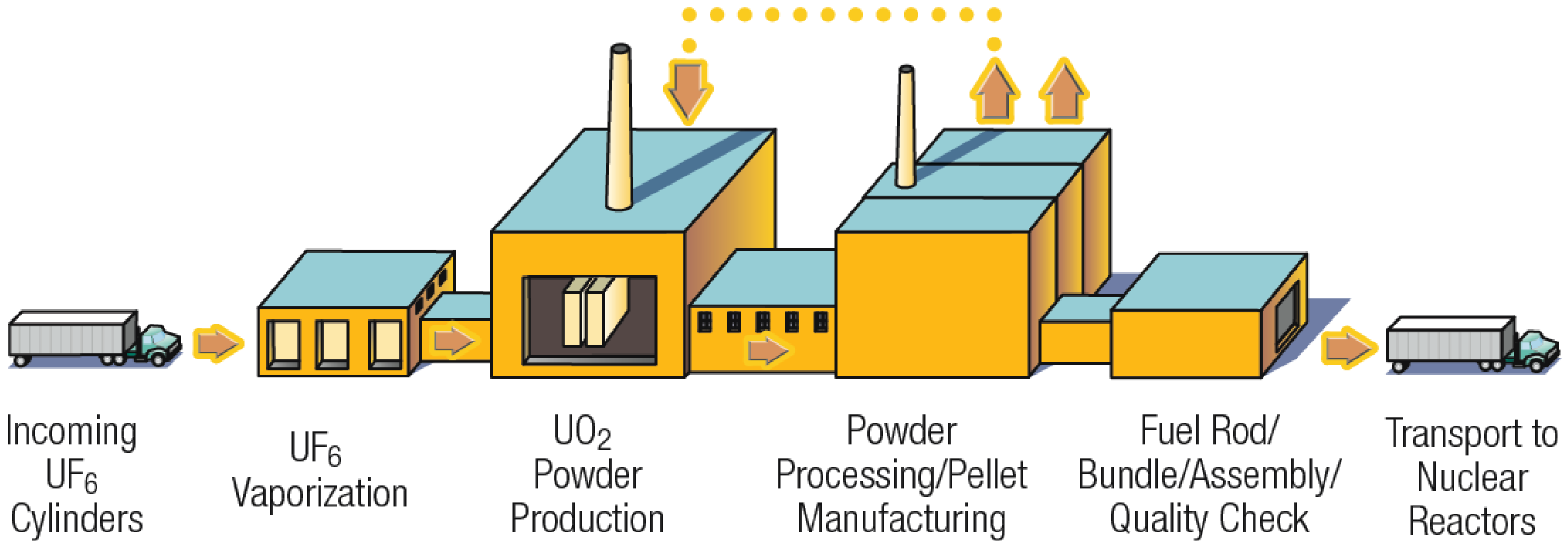
(1) the chemical conversion of UF_6 to UO_2 powder

(2) a ceramic process that converts UO_2 powder to small ceramic pellets

(3) a mechanical process that loads the fuel pellets into rods and constructs finished fuel assemblies

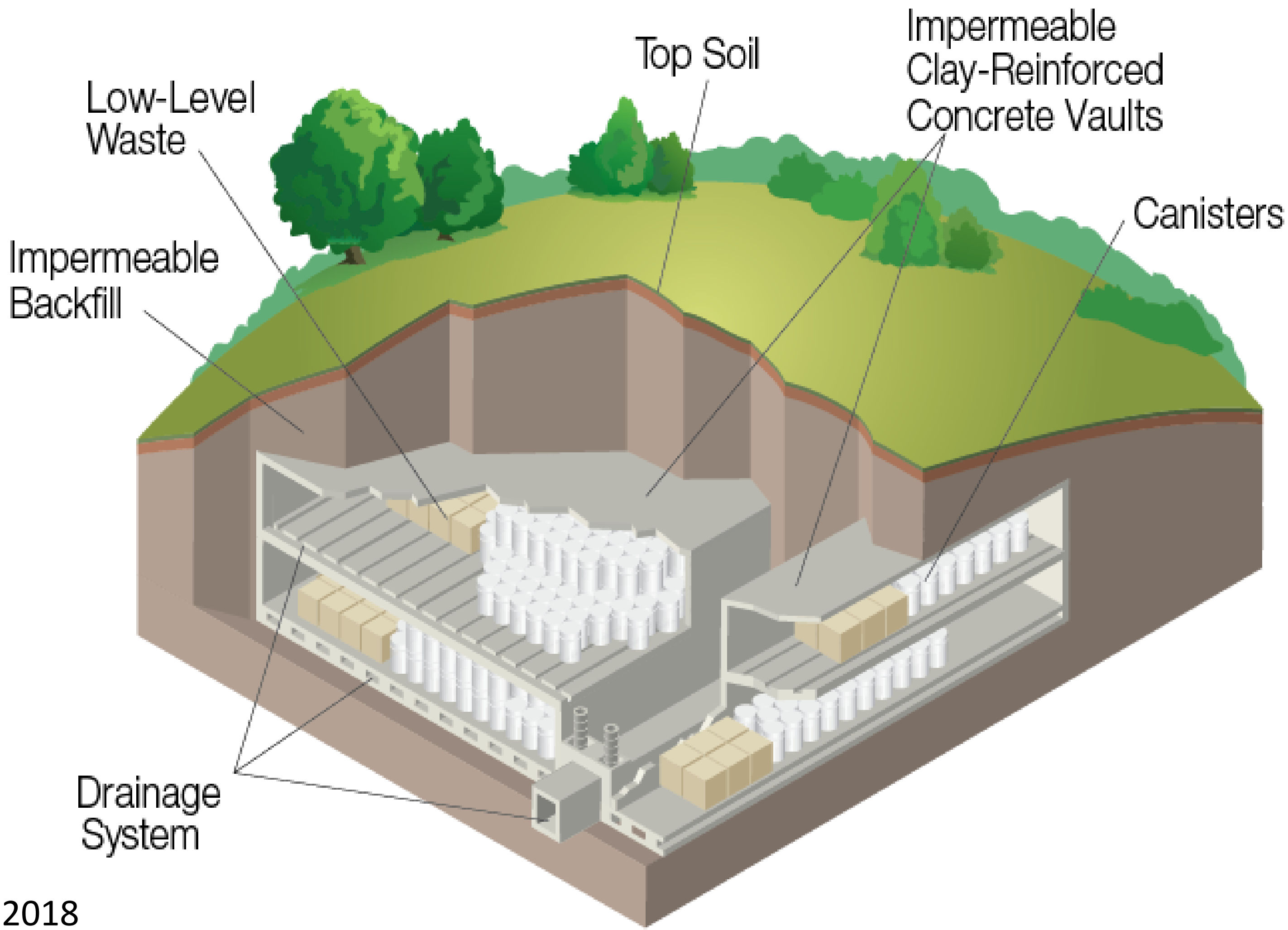
As of July 2018

Simplified Fuel Fabrication Process



As of July 2018

Low-Level Radioactive Waste Disposal



As of July 2018

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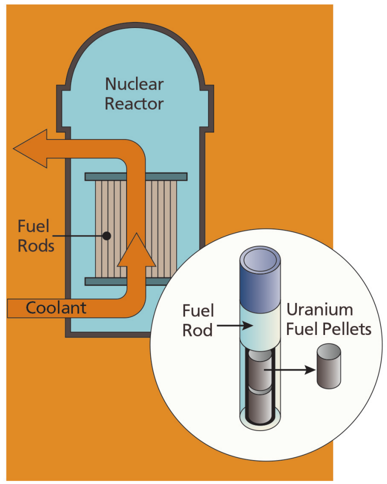
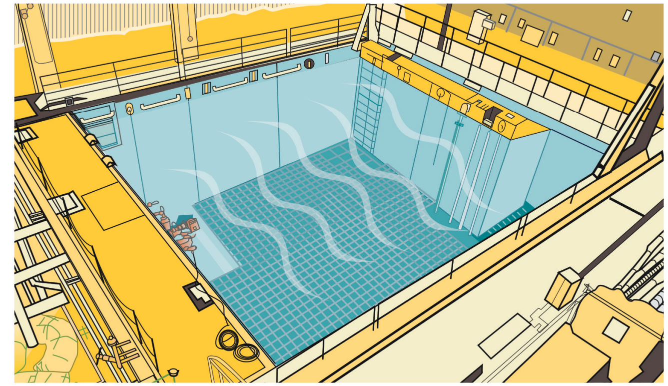
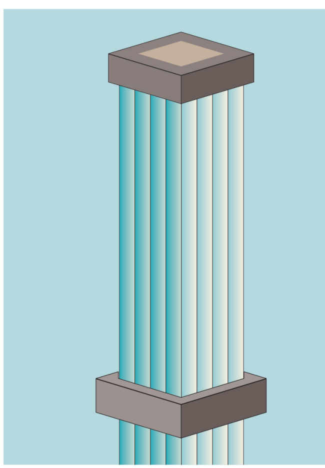
Spent Fuel Generation and Storage After Use

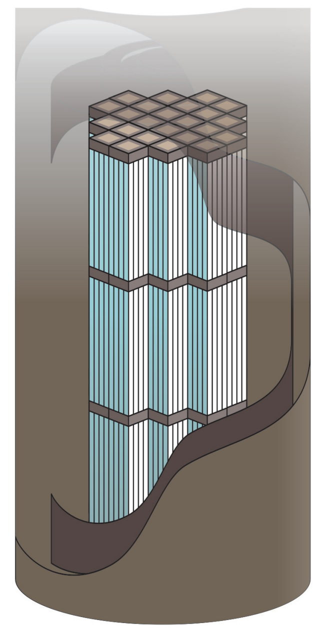
1 A nuclear reactor is powered by enriched uranium-235 fuel. Fission (splitting of atoms) generates heat, which produces steam that turns turbines to produce electricity. A reactor rated at several hundred megawatts may contain 100 or more tons of fuel in the form of bullet-sized pellets loaded into long metal rods that are bundled together into fuel assemblies. Pressurized-water reactors (PWRs) contain between 120 and 200 fuel assemblies. Boiling-water reactors (BWRs) contain between 370 and 800 fuel assemblies.







2 After 5–6 years, spent fuel assemblies (which are typically 14 feet [4.3 meters] long and which contain nearly 200 fuel rods for PWRs and 80–100 fuel rods for BWRs) are removed from the reactor and allowed to cool in storage pools. At this point, the 900-pound (409-kilogram) assemblies contain only about one-fifth the original amount of uranium-235.

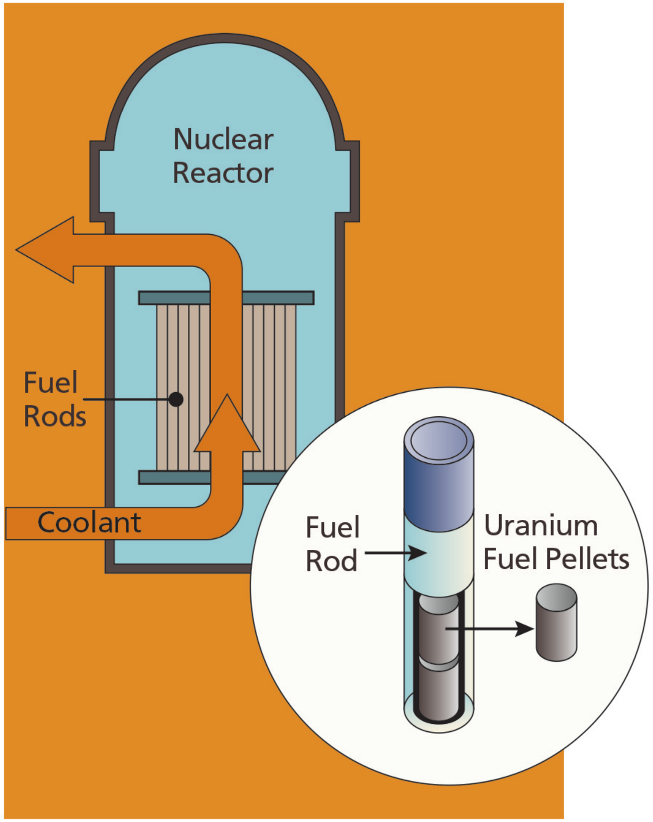


3 Commercial light-water nuclear reactors store spent radioactive fuel in a steel-lined, seismically designed concrete pool under about 40 feet (12.2 meters) of water that provides shielding from radiation. Pumps supply continuously flowing water to cool the spent fuel. Extra water for the pool is provided by other pumps that can be powered from an onsite emergency diesel generator. Support features, such as water-level monitors and radiation detectors, are also in the pool. Spent fuel is stored in the pool until it is transferred to dry casks on site (as shown in Figure 34) or transported off site for interim storage or disposal.

As of July 2018

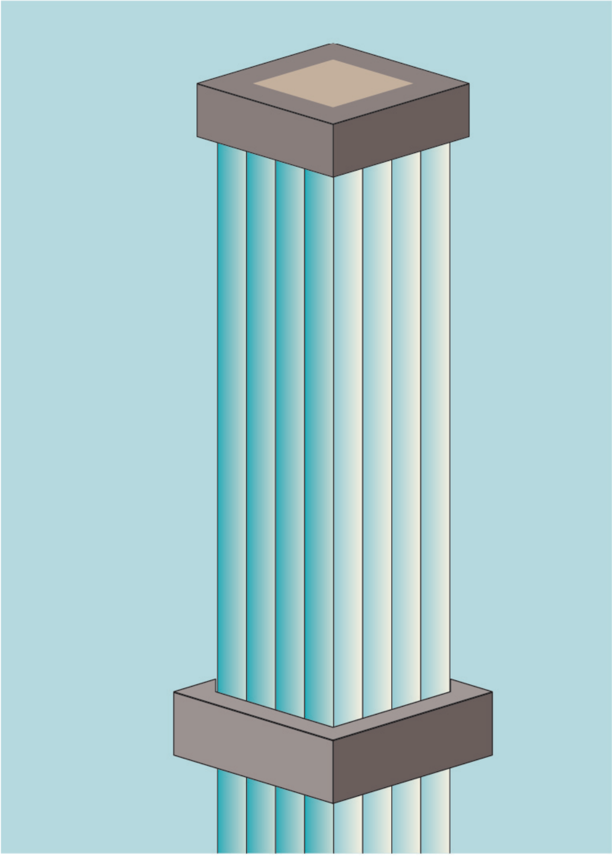
Spent Fuel Generation and Storage After Use

1 A nuclear reactor is powered by enriched uranium-235 fuel. Fission (splitting of atoms) generates heat, which produces steam that turns turbines to produce electricity. A reactor rated at several hundred megawatts may contain 100 or more tons of fuel in the form of bullet-sized pellets loaded into long metal rods that are bundled together into fuel assemblies. Pressurized-water reactors (PWRs) contain between 120 and 200 fuel assemblies. Boiling-water reactors (BWRs) contain between 370 and 800 fuel assemblies.



As of July 2018

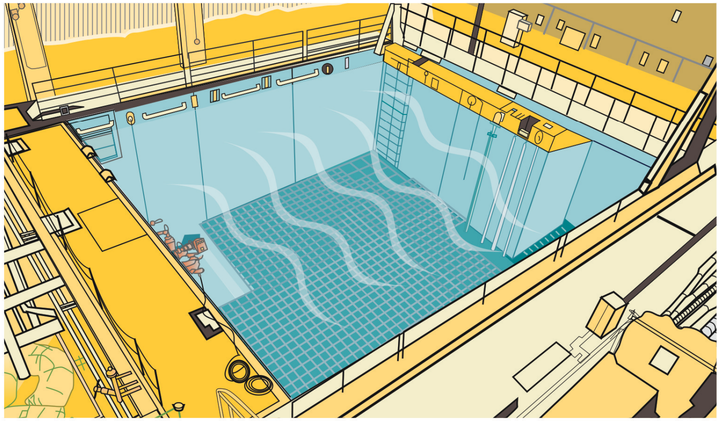
Spent Fuel Generation and Storage After Use

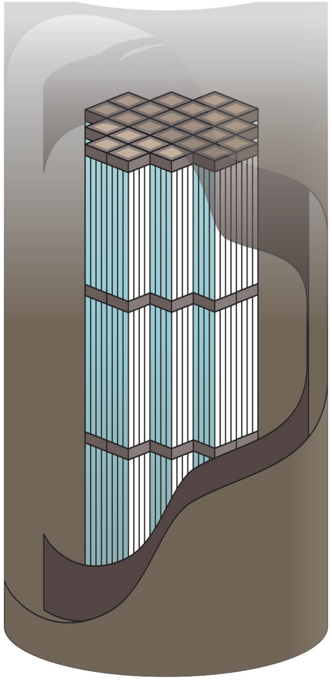


2 *After 5–6 years, spent fuel assemblies (which are typically 14 feet [4.3 meters] long and which contain nearly 200 fuel rods for PWRs and 80–100 fuel rods for BWRs) are removed from the reactor and allowed to cool in storage pools. At this point, the 900-pound (409-kilogram) assemblies contain only about one-fifth the original amount of uranium-235.*

As of July 2018

Spent Fuel Generation and Storage After Use





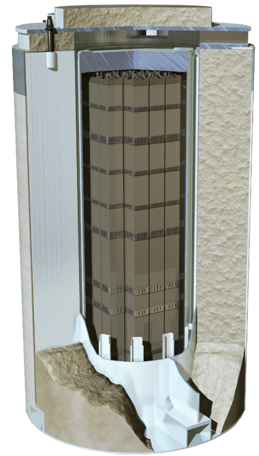
3 Commercial light-water nuclear reactors store spent radioactive fuel in a steel-lined, seismically designed concrete pool under about 40 feet (12.2 meters) of water that provides shielding from radiation. Pumps supply continuously flowing water to cool the spent fuel. Extra water for the pool is provided by other pumps that can be powered from an onsite emergency diesel generator. Support features, such as water-level monitors and radiation detectors, are also in the pool. Spent fuel is stored in the pool until it is transferred to dry casks on site (as shown in Figure 34) or transported off site for interim storage or disposal.

As of July 2018

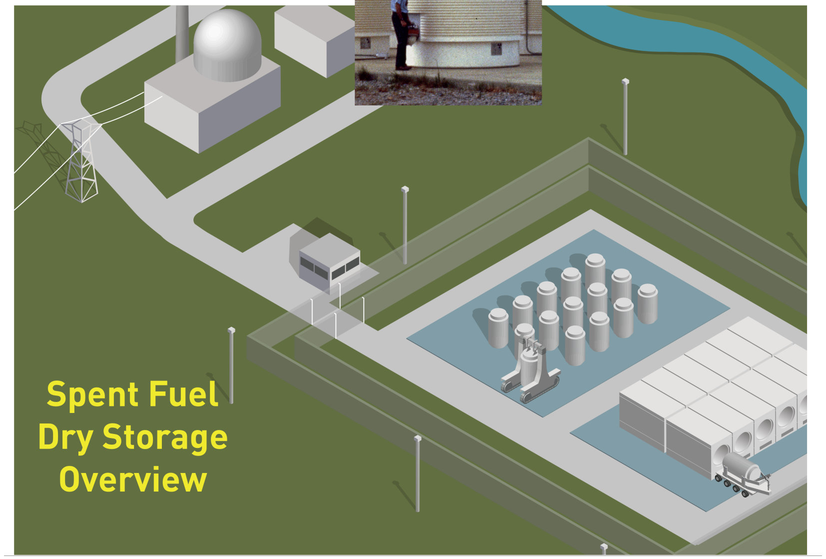
Dry Storage of Spent Nuclear Fuel

At nuclear reactors across the country, spent fuel is kept on site, typically above ground, in systems basically similar to the ones shown here. The NRC reviews and approves the designs of these spent fuel storage systems before they can be used.

1 Once the spent fuel has sufficiently cooled, it is loaded into special canisters that are designed to hold nuclear fuel assemblies. Water and air are removed. The canister is filled with inert gas, welded shut, and rigorously tested for leaks. It is then placed in a cask for storage or transportation. The dry casks are then loaded onto concrete pads.

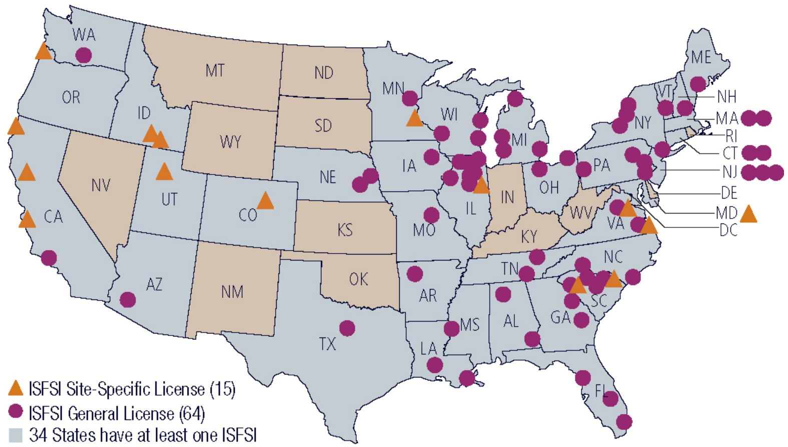


2 The canisters can also be stored in aboveground concrete bunkers, each of which is about the size of a one-car garage.



As of July 2018

Licensed and Operating Independent Spent Fuel Storage Installations by State



ALABAMA
- ● Browns Ferry
- ● Farley

ARIZONA
- ● Palo Verde

ARKANSAS
- ● Arkansas Nuclear

CALIFORNIA
- ▲ Diablo Canyon
- ▲ Rancho Seco
- ● San Onofre
- ▲ Humboldt Bay

COLORADO
- ▲ Fort St. Vrain

CONNECTICUT
- ● Haddam Neck
- ● Millstone

FLORIDA
- ● Crystal River
- ● St. Lucie
- ● Turkey Point

GEORGIA
- ● Hatch
- ● Vogtle

IDAHO
- ▲ DOE: Three Mile Island-2 (Fuel Debris)
- ▲ DOE: Idaho Spent Fuel Facility

ILLINOIS
- ● Braidwood
- ● Byron
- ● Clinton
- ▲ GEH Morris (Wet)
- ● Dresden
- ● La Salle
- ● Quad Cities
- ● Zion

IOWA
- ● Duane Arnold

LOUISIANA
- ● River Bend
- ● Waterford

MAINE
- ● Maine Yankee

MARYLAND
- ▲ Calvert Cliffs

MASSACHUSETTS
- ● Yankee Rowe
- ● Pilgrim

MICHIGAN
- ● Big Rock Point
- ● Palisades
- ● Cook
- ● Fermi

MINNESOTA
- ● Monticello
- ▲ Prairie Island

MISSISSIPPI
- ● Grand Gulf

MISSOURI
- ● Callaway

NEBRASKA
- ● Cooper
- ● Ft. Calhoun

NEW HAMPSHIRE
- ● Seabrook

NEW JERSEY
- ● Hope Creek
- ● Salem
- ● Oyster Creek

NEW YORK
- ● Indian Point
- ● FitzPatrick
- ● Ginna
- ● Nine Mile Point

NORTH CAROLINA
- ● Brunswick
- ● McGuire

OHIO
- ● Davis-Besse
- ● Perry

OREGON
- ▲ Trojan

PENNSYLVANIA
- ● Limerick
- ● Susquehanna
- ● Peach Bottom
- ● Beaver Valley
- ● Three Mile Island

SOUTH CAROLINA
- ●▲ Oconee
- ●▲ Robinson
- ● Catawba
- ● Summer

TENNESSEE
- ● Sequoyah
- ● Watts Bar

TEXAS
- ● Comanche Peak

UTAH
- ▲ Private Fuel Storage*

VERMONT
- ● Vermont Yankee

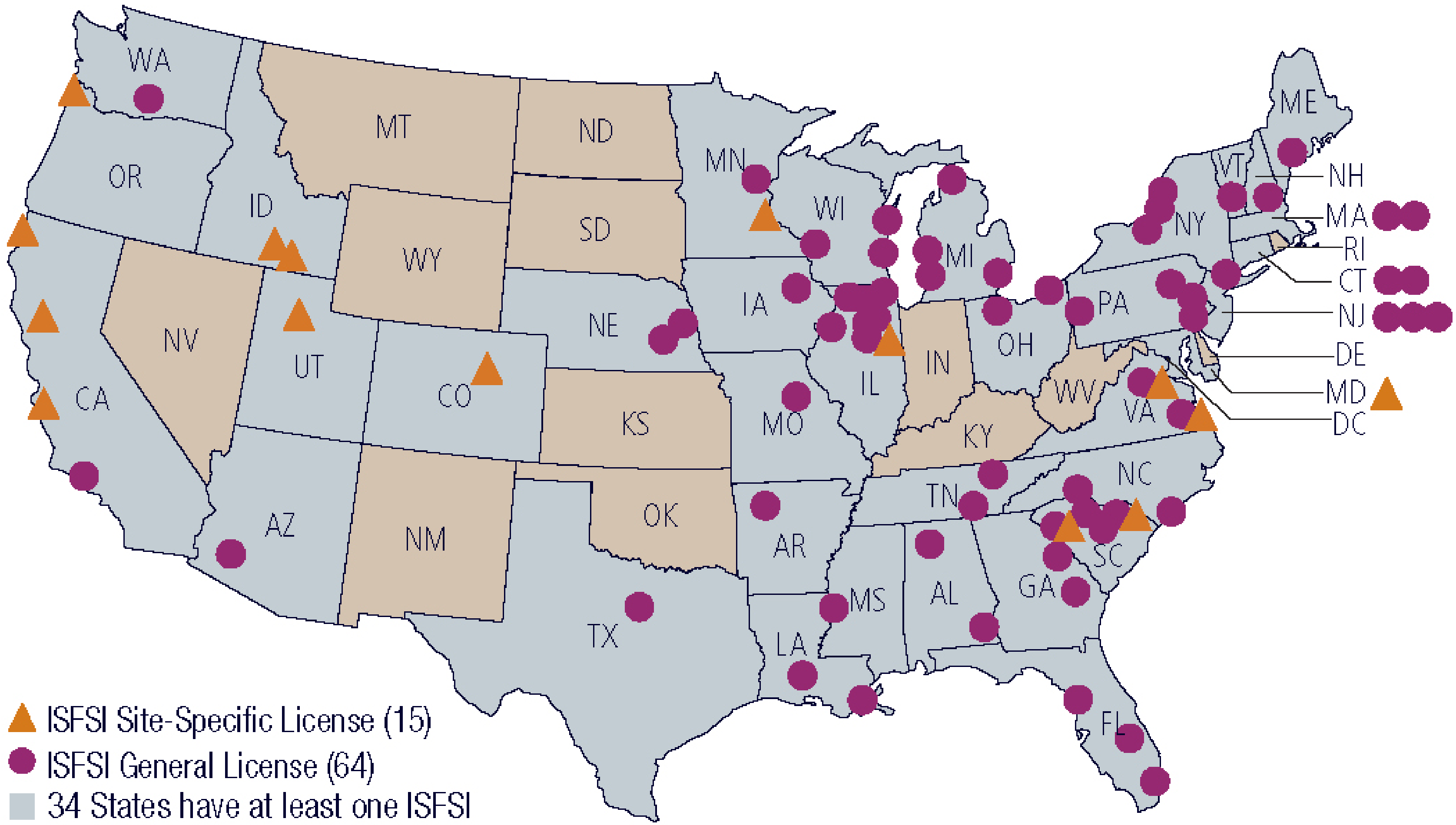
VIRGINIA
- ●▲ Surry
- ●▲ North Anna

WASHINGTON
- ● Columbia

WISCONSIN
- ● Point Beach
- ● Kewaunee
- ● LaCrosse

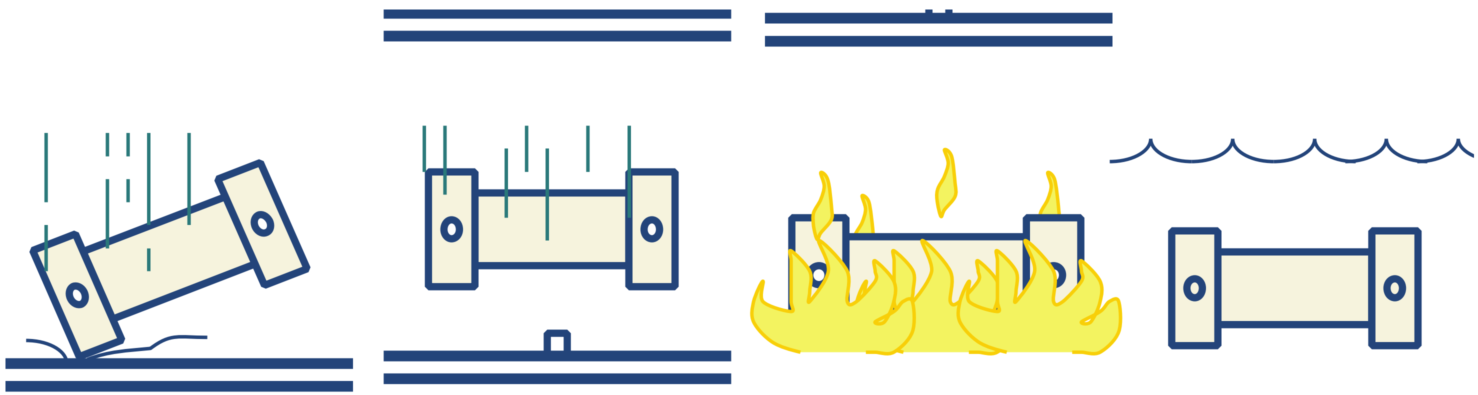
As of July 2018

Licensed and Operating Independent Spent Fuel Storage Installations by State



As of July 2018

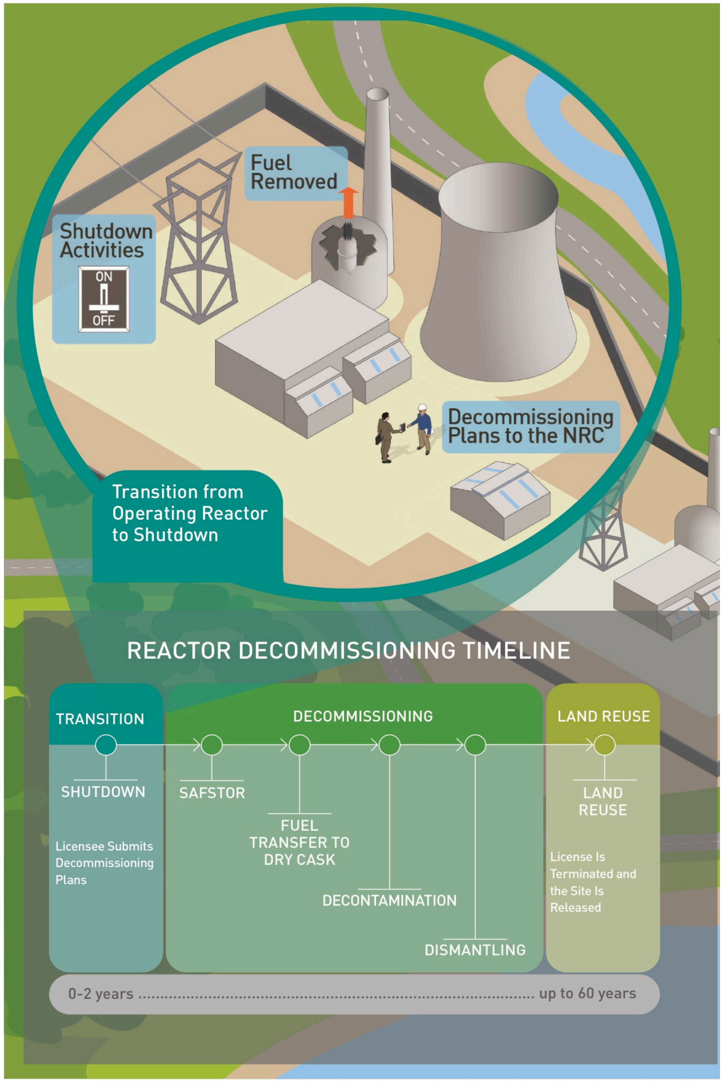
Ensuring Safe Spent Fuel Shipping Containers



The impact (free drop and puncture), fire, and water immersion tests are considered in sequence to determine their cumulative effects on a given package.

As of July 2018

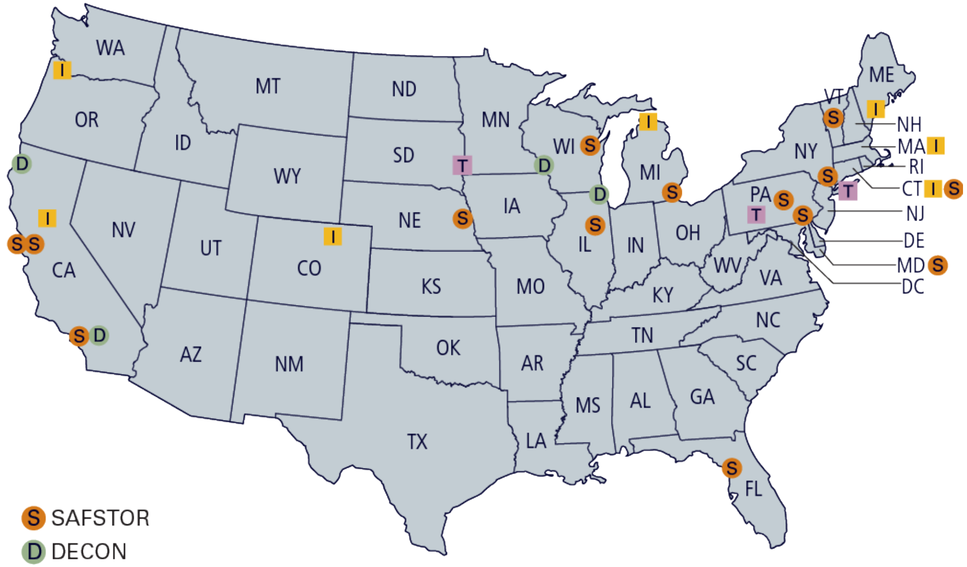
Reactor Decommissioning Overview Timeline



As of July 2018

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Power Reactor Decommissioning Status



S SAFSTOR
D DECON

Decommissioning Completed
I ISFSI (Independent Spent Fuel Storage Installation) only
T License Terminated (no fuel on site)

CALIFORNIA
S GE EVESR
S GE VBWR
D Humboldt Bay 3
I Rancho Seco
S San Onofre 1
D San Onofre 2 and 3

COLORADO
I Fort St. Vrain
(DOE License)

CONNECTICUT
S Millstone 1
I Haddam Neck

FLORIDA
S Crystal River 3

ILLINOIS
S Dresden 1
D Zion 1 and 2

MARYLAND
S N.S. Savannah

MASSACHUSETTS
I Yankee Rowe

MAINE
I Maine Yankee

MICHIGAN
S Fermi 1
I Big Rock Point

NEBRASKA
S Fort Calhoun

NEW YORK
S Indian Point 1
T Shoreham

OREGON
I Trojan

PENNSYLVANIA
T Saxton
S Peach Bottom 1
S Three Mile Island 2

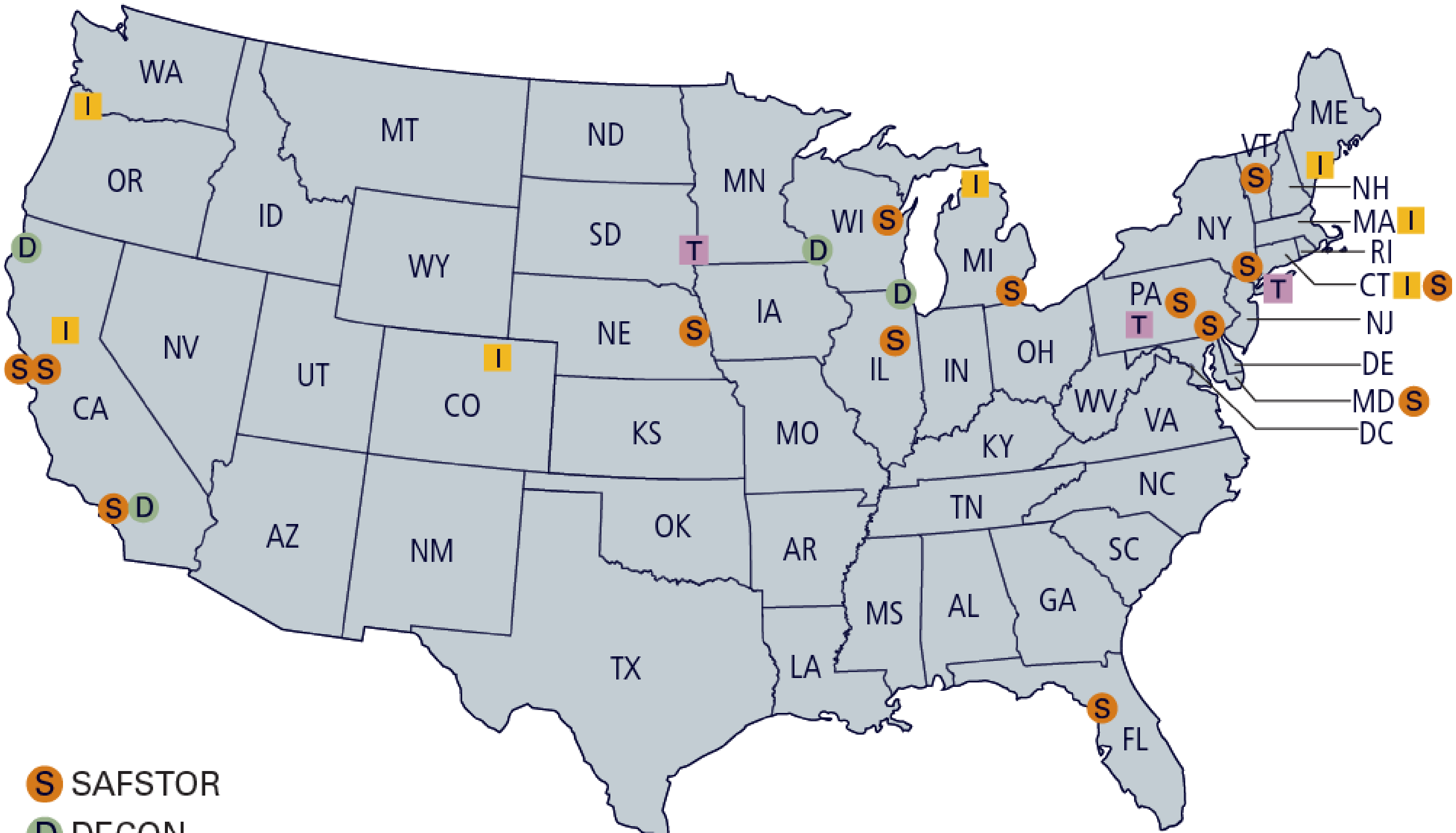
SOUTH DAKOTA
T Pathfinder

VERMONT
S Vermont Yankee

WISCONSIN
D LaCrosse
S Kewaunee

As of July 2018

Power Reactor Decommissioning Status



S SAFSTOR

D DECON

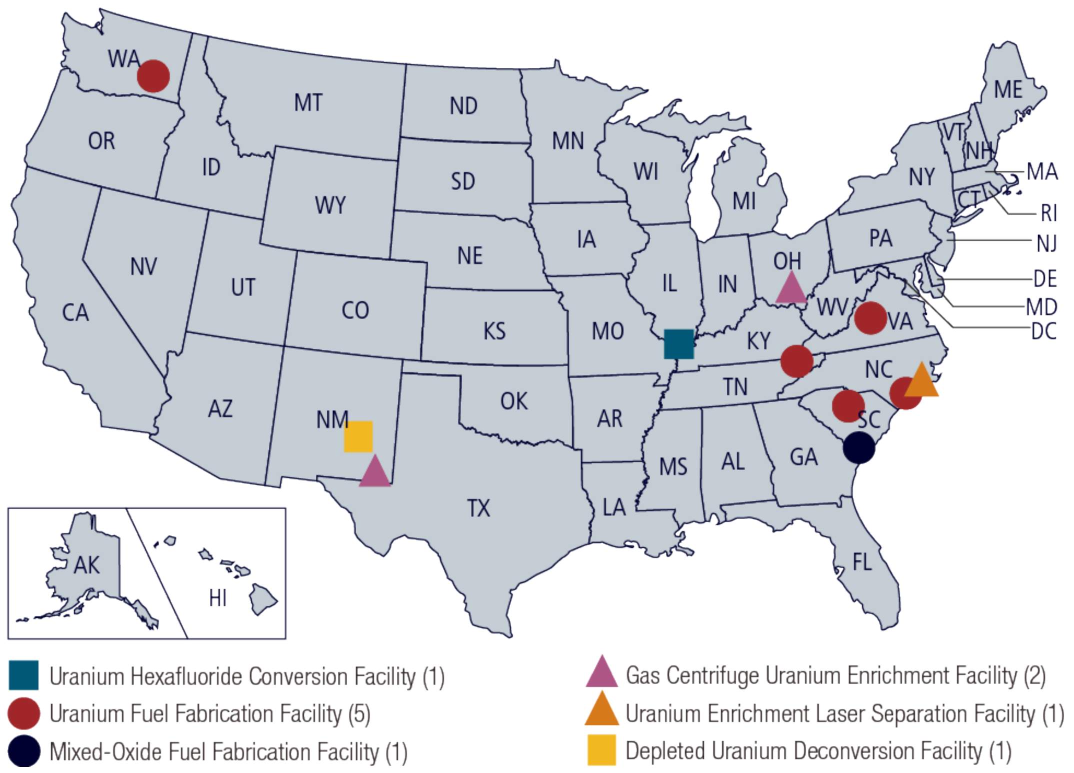
Decommissioning Completed

I ISFSI (Independent Spent Fuel Storage Installation) only

T License Terminated (no fuel on site)

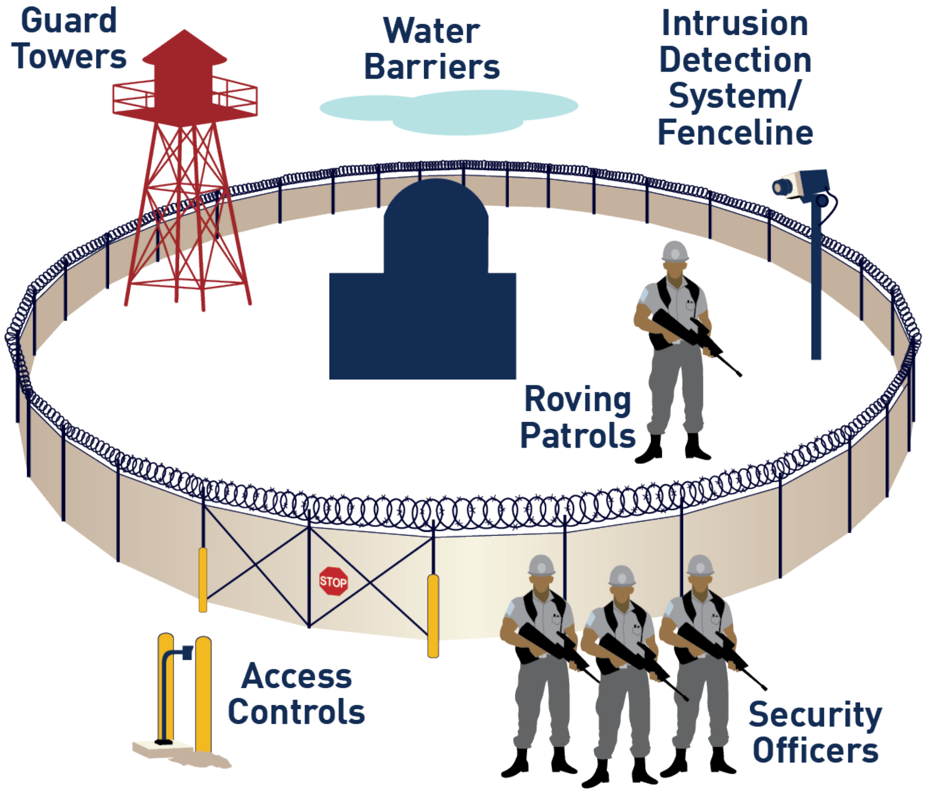
As of July 2018

Locations of NRC-Regulated Sites Undergoing Decommissioning



As of July 2018

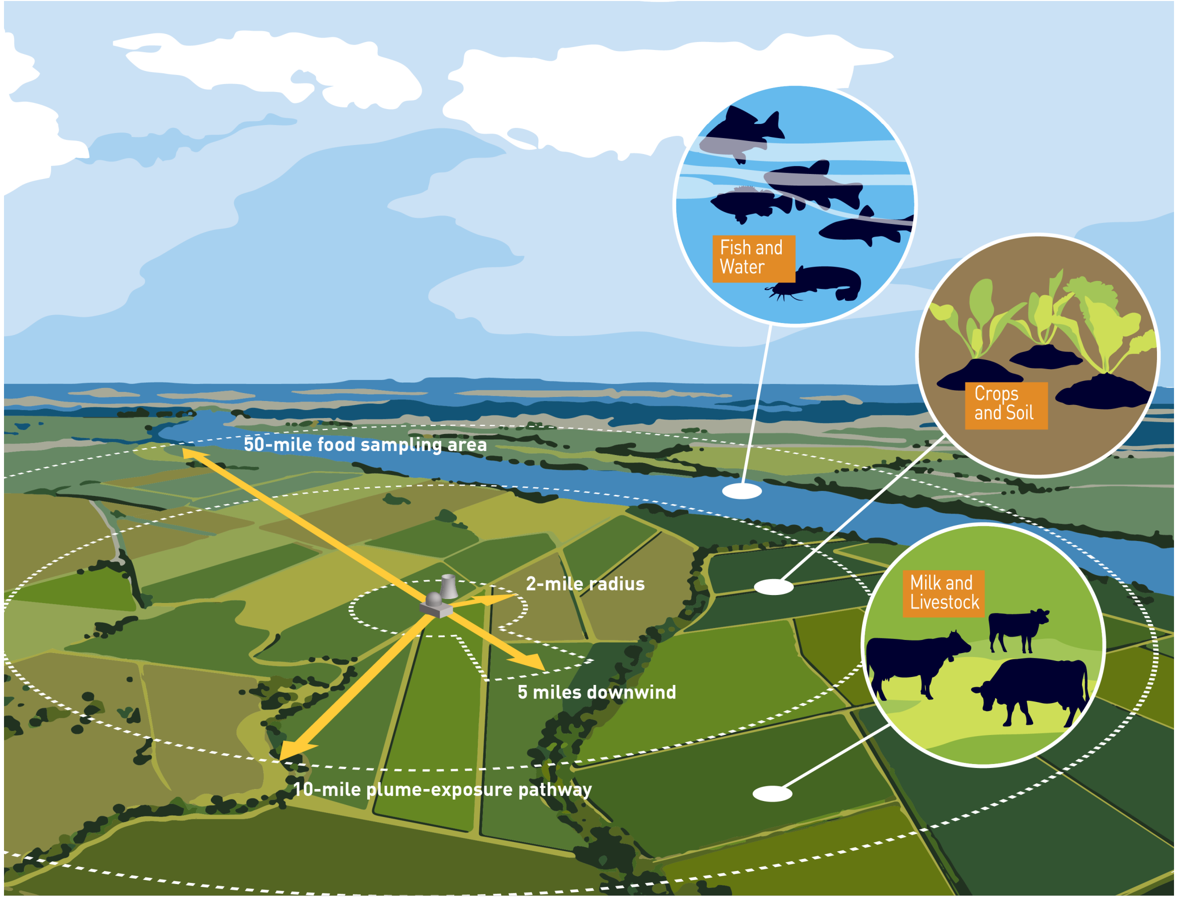
Security Components



As of July 2018

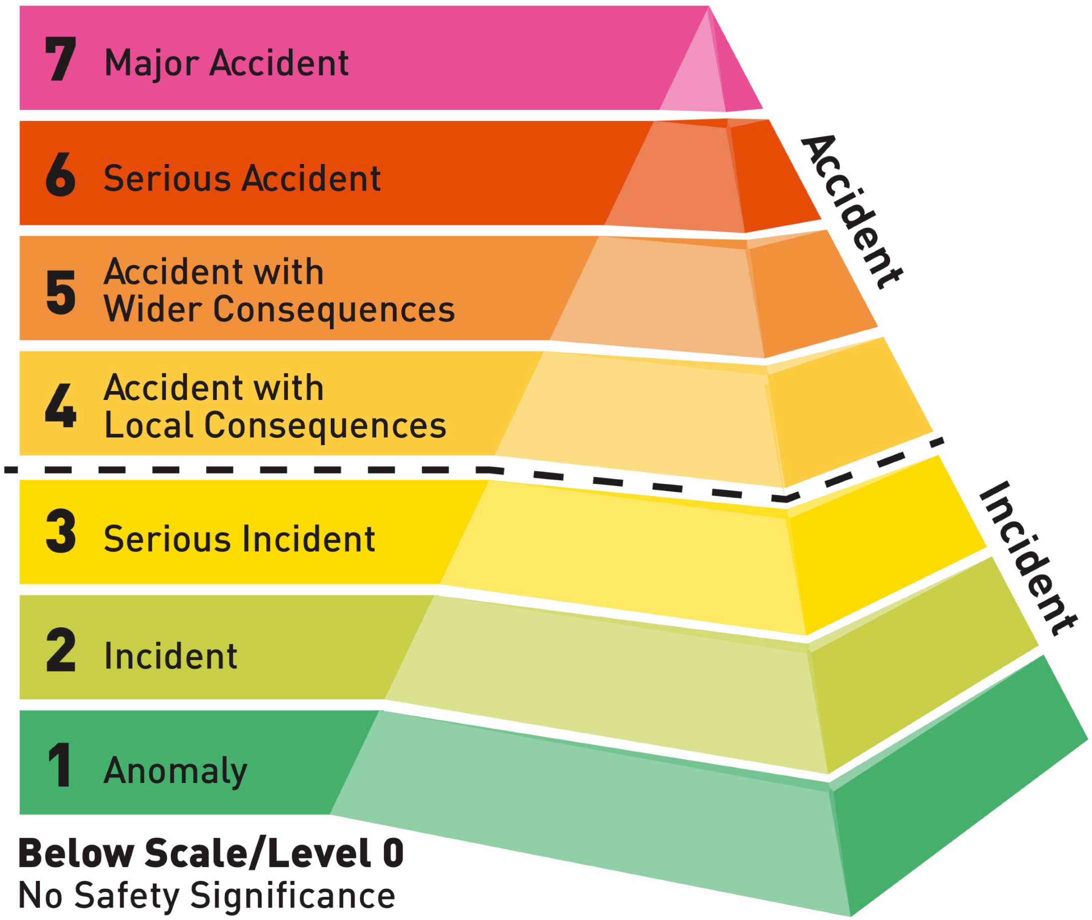
U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Emergency Planning Zones



As of July 2018

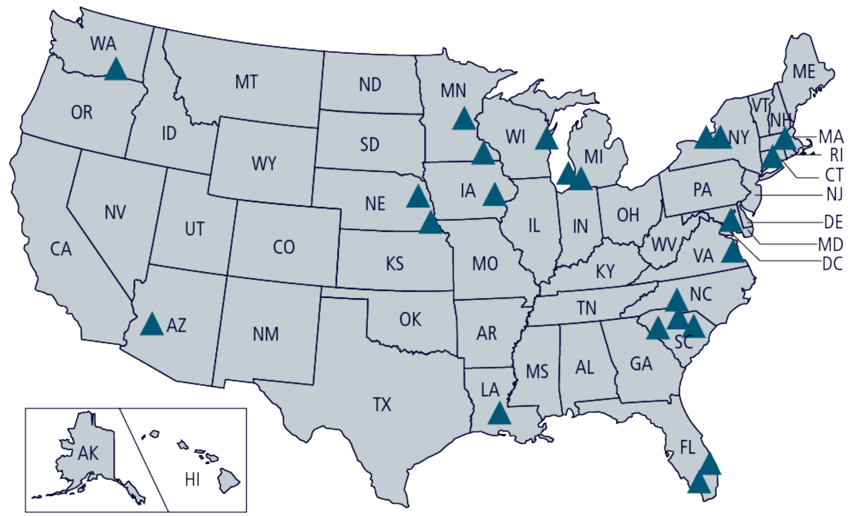
The International Nuclear and Radiological Event Scale



INES events are classified on the scale at seven levels. Levels 1–3 are called incidents and Levels 4–7 are called accidents. The scale is designed so that the severity of an event is about 10 times greater for each increase in level on the scale. Events without safety significance are called deviations and are classified as Below Scale or at Level 0.

As of July 2018

Native American Reservations and Trust Lands within a 50-Mile Radius of a Nuclear Power Plant



ARIZONA
- **Palo Verde**
  - Ak-Chin Indian Community
  - Tohono O'odham Trust Land
  - Gila River Reservation

CONNECTICUT
- **Millstone**
  - Mohegan Reservation
  - Mashantucket Pequot Reservation
  - Narragansett Reservation
  - Shinnecock Indian Nation

FLORIDA
- **St. Lucie**
  - Brighton Reservation (Seminole Tribes of Florida)
  - Fort Pierce Reservation
- **Turkey Point**
  - Hollywood Reservation (Seminole Tribes of Florida)
  - Miccosukee Reservation
  - Miccosukee Trust Land

IOWA
- **Duane Arnold**
  - Sac & Fox Trust Land
  - Sac & Fox Reservation

LOUISIANA
- **River Bend**
  - Tunica-Biloxi Reservation

MASSACHUSETTS
- **Pilgrim**
  - Wampanoag Tribe of Gay Head (Aquinnah) Trust Land

MARYLAND
- **Calvert Cliffs**
  - Rappahannock Tribe

MICHIGAN
- **Palisades**
  - Pottawatomi Reservation Matchebenashshewish Band
  - Pokagon Reservation
  - Pokagon Trust Land*
- **DC Cook**
  - Pokagon Reservation
  - Pokagon Trust Land

MINNESOTA
- **Monticello**
  - Shakopee Community
  - Shakopee Trust Land
  - Mille Lacs Reservation
- **Prairie Island**
  - Prairie Island Community*
  - Prairie Island Trust Land*
  - Shakopee Community
  - Shakopee Trust Land

NEBRASKA
- **Cooper**
  - Sac & Fox Trust Land
  - Sac & Fox Reservation
  - Iowa Reservation
  - Iowa Trust Land
  - Kickapoo

NEW YORK
- **FitzPatrick**
  - Onondaga Reservation
  - Oneida Reservation
- **Nine Mile Point**
  - Onondaga Reservation
  - Oneida Reservation

NORTH CAROLINA
- **McGuire**
  - Catawba Reservation

SOUTH CAROLINA
- **Catawba**
  - Catawba Reservation
- **Oconee**
  - Eastern Cherokee Reservation
- **Summer**
  - Catawba Reservation

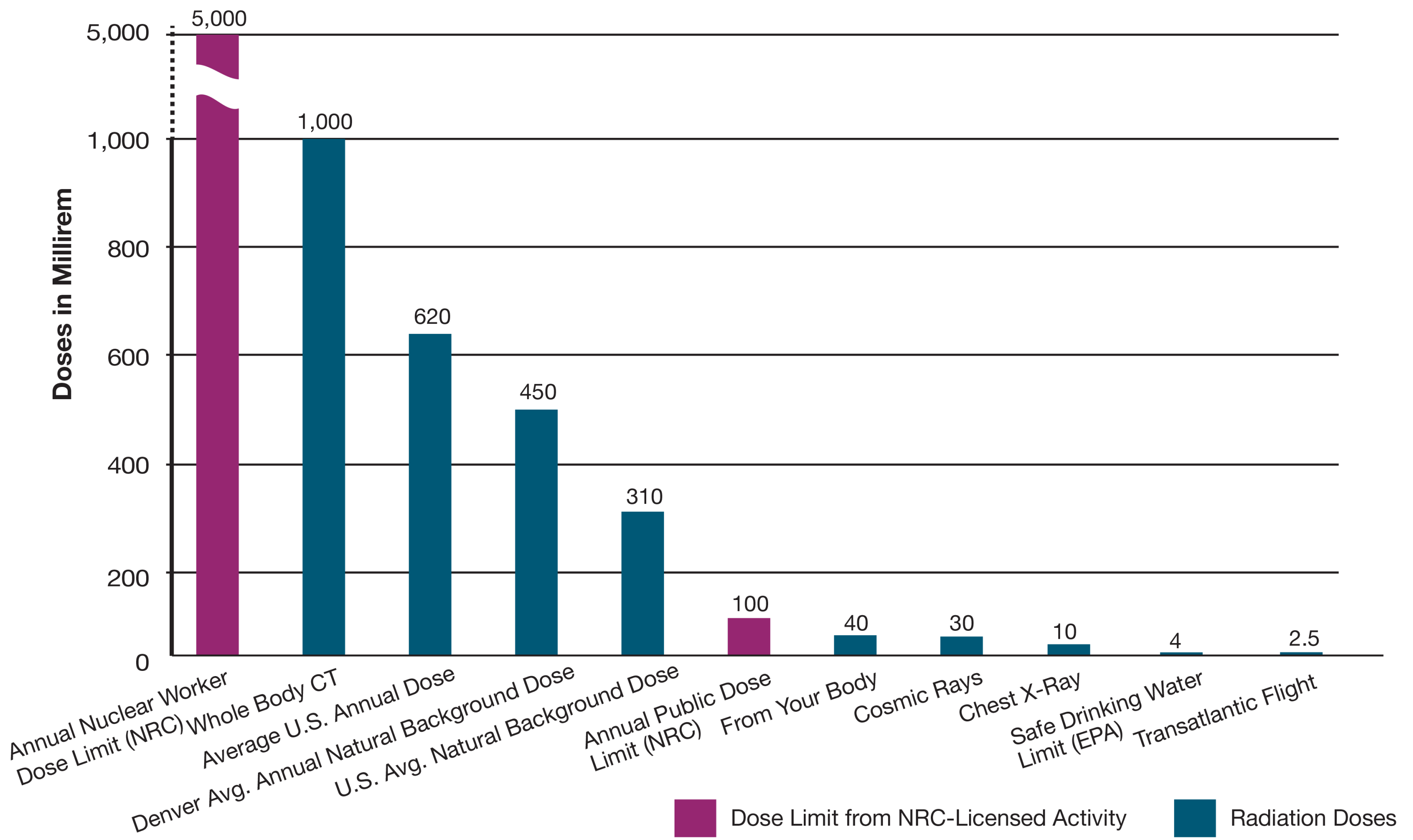
VIRGINIA
- **Surry**
  - Pamunkey Reservation
  - Chickahominy Indian Tribe
  - Chickahominy Indian Tribe — Eastern Division
  - Nansemond Indian Tribe
  - Upper Mattaponi Tribe

WASHINGTON
- **Columbia**
  - Yakama Reservation
  - Yakama Trust Land

WISCONSIN
- **Point Beach**
  - Oneida Trust Land
  - Oneida Reservation

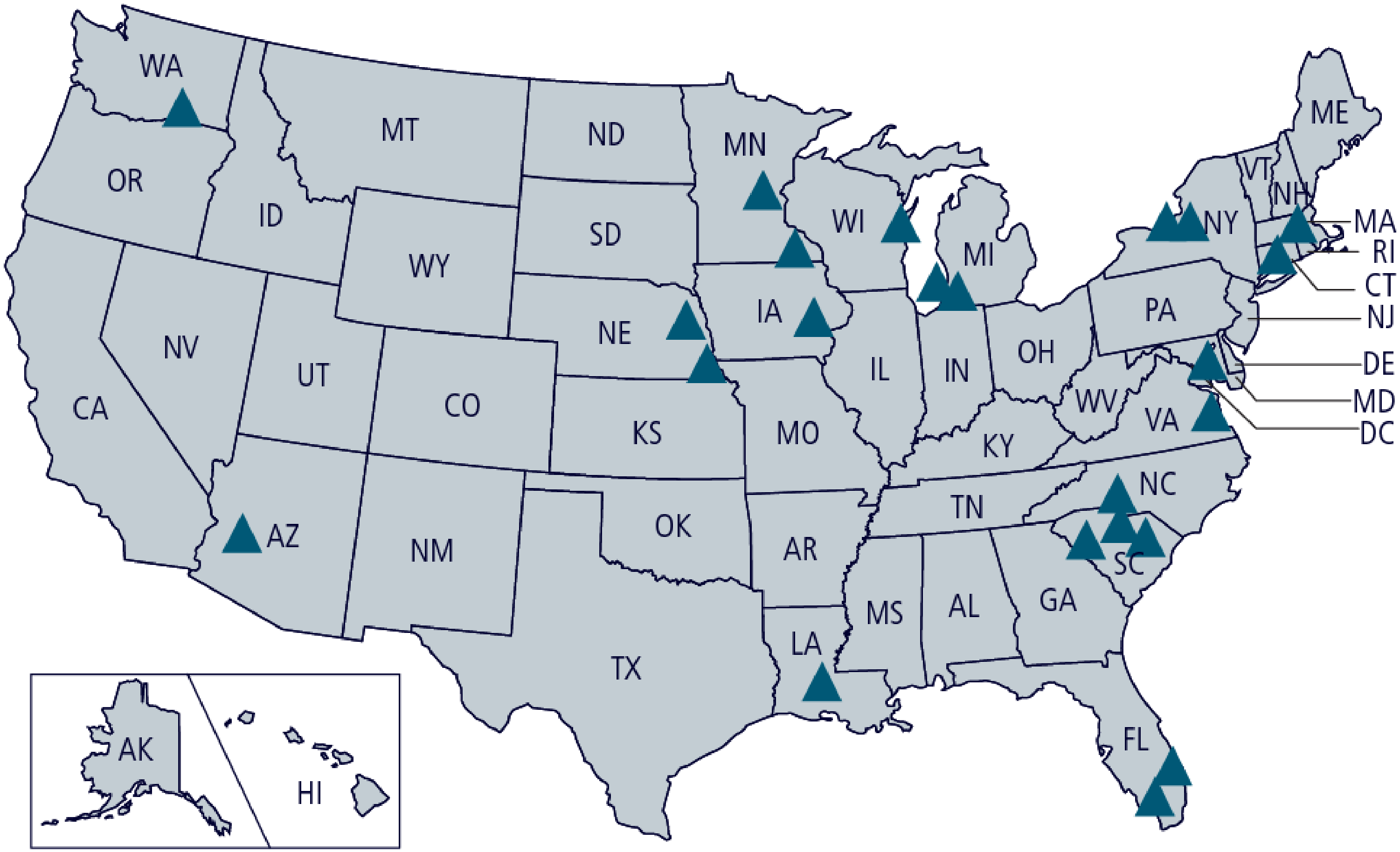
As of July 2018

Radiation Doses and Regulatory Limits



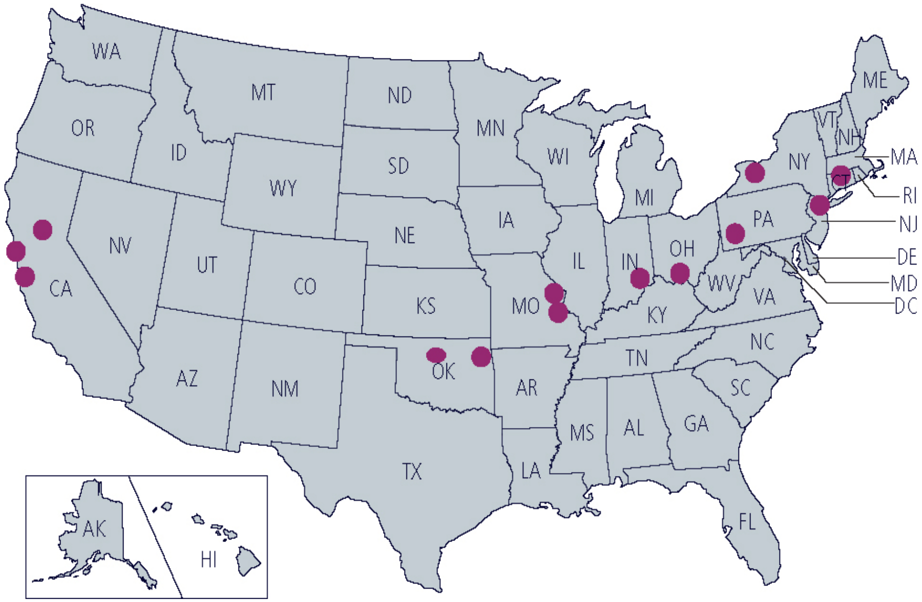
As of July 2018

Native American Reservations and Trust Lands within a 50-Mile Radius of a Nuclear Power Plant



As of July 2018

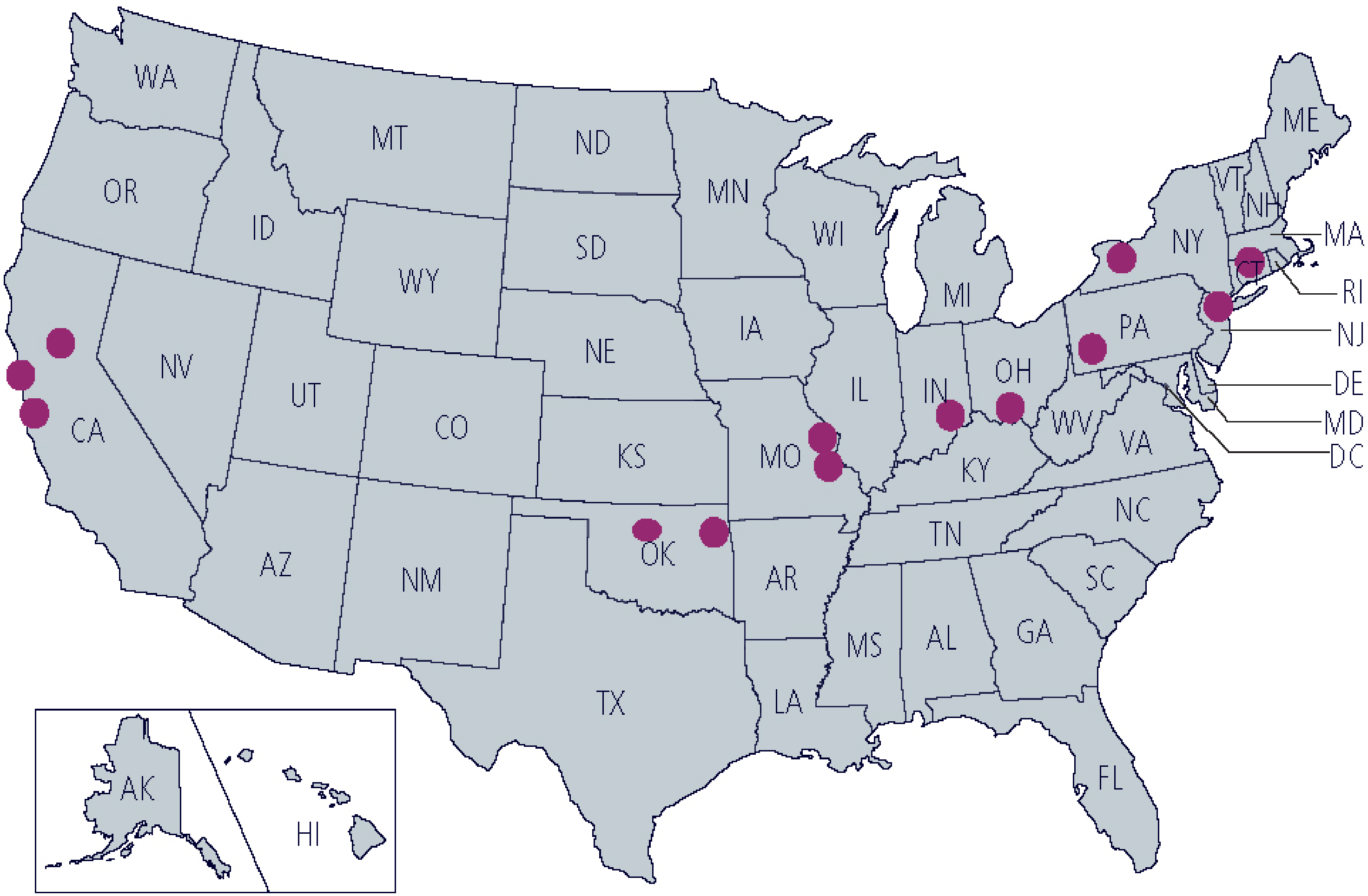
NRC-Regulated Complex Materials Sites Undergoing Decommissioning



Company	Location
Alameda Naval Air Station	Alameda, CA
BWX Technology, Inc., Shallow Land Disposal Area	Vandergrift, PA
Cimarron Environmental Response Trust	Cimarron City, OK
Department of Army, Jefferson Proving Ground	Madison, IN
Department of Army, Picatinny Arsenal (ARDEC)	Picatinny, NJ
FMRI, Inc. (Fansteel)	Muskogee, OK
Hunter's Point Naval Shipyard	San Francisco, CA
Lead Cascade (Centrus)	Piketon, OH
McClellan Air Force Base	Sacramento, CA
Sigma Aldrich	Maryland Heights, MO
UNC Naval Products	New Haven, CT
West Valley Demonstration Project	West Valley, NY
Westinghouse Electric Corporation—Hematite	Festus, MO

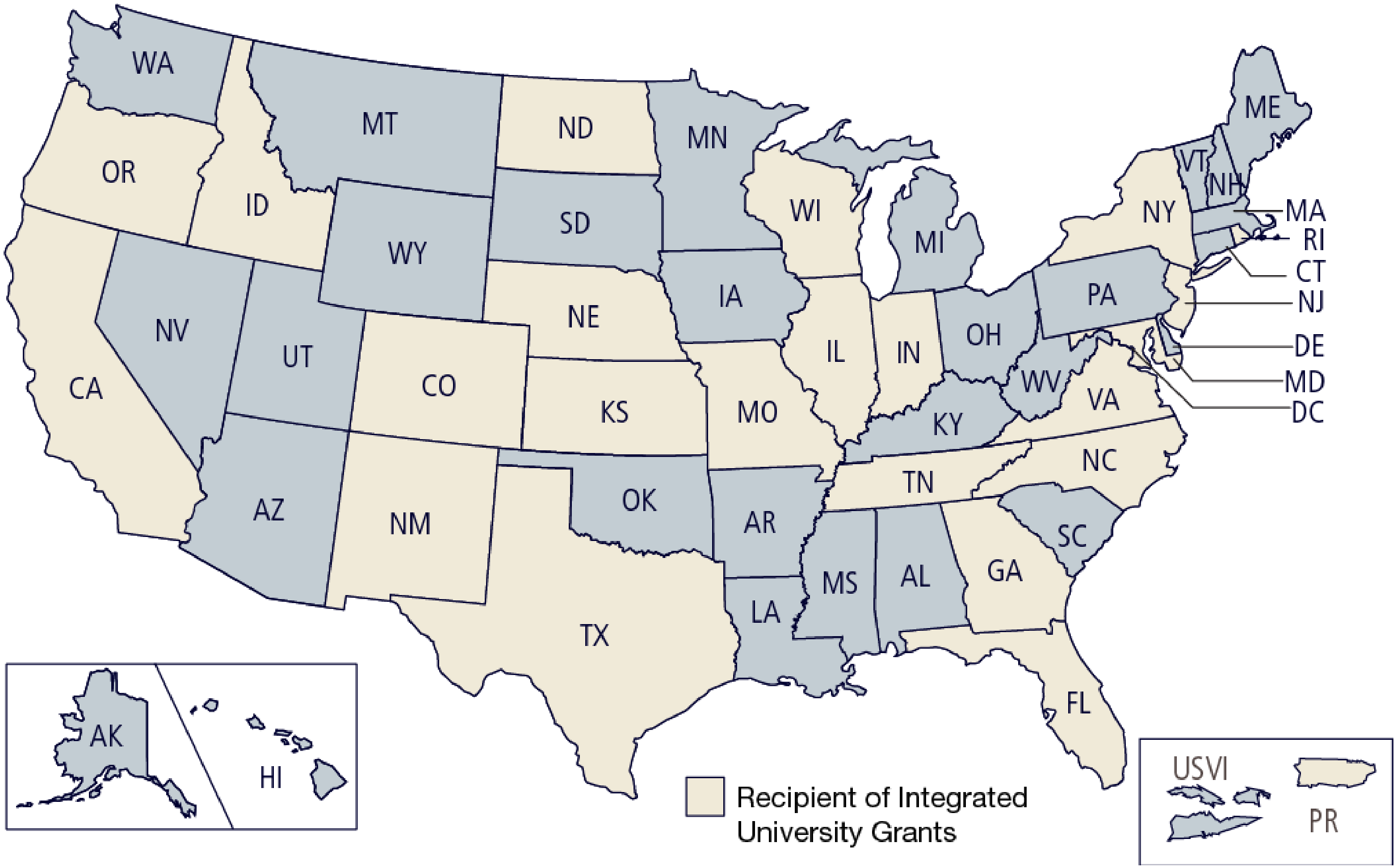
As of July 2018

NRC-Regulated Complex Materials Sites Undergoing Decommissioning



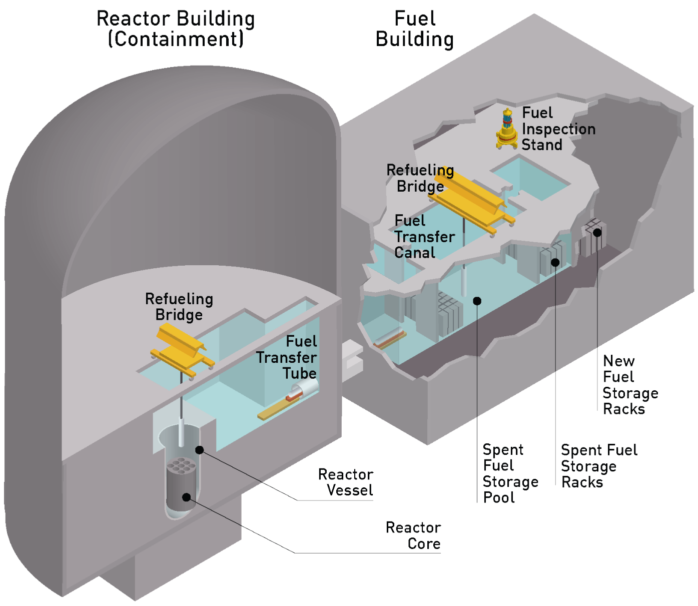
As of July 2018

States with Integrated University Grants Program Recipients in FY 2017



As of July 2018

Pressurized-Water Reactor Refueling

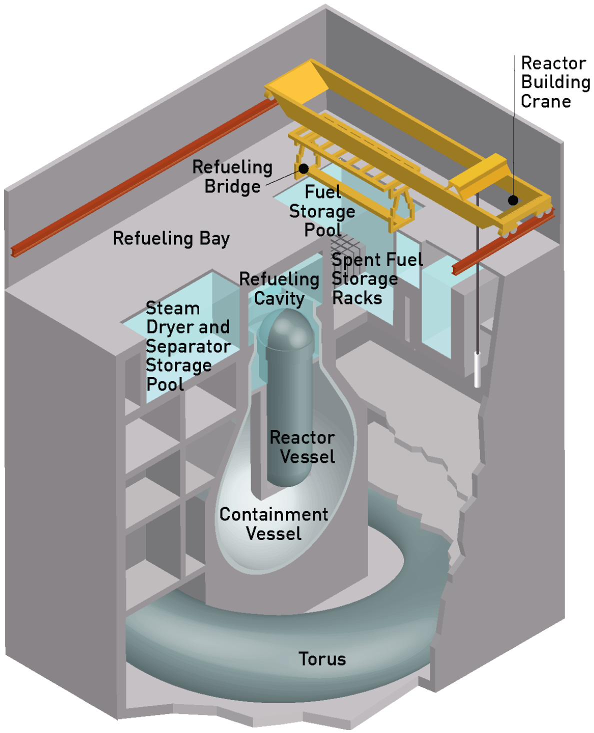


PWR Refueling Summary:

As new fuel shipping canisters arrive in the fuel building, the reactor building crane (not shown) lifts them to the fuel inspection stand, where the fuel is removed from the canister and inspected for defects. Fuel in the new fuel storage area is moved into the fuel pool prior to refueling activities. The fuel can then be stored in either the new fuel storage racks (which are dry), or in the refueling pool, depending upon the needs of the site. Fuel in the new fuel storage area is moved into the fuel pool prior to refueling activities. To refuel the reactor, the vessel head is removed, the fuel transfer canals and transfer tube areas are flooded, and removable gates are opened in order to connect the refueling canal to the fuel pool. The reactor building refueling bridge is used to remove a fuel assembly from the reactor vessel and transfer it to the "up-ender" basket, which is then tilted until it is horizontal, sent through the transfer tube into the fuel building, and returned upright. The refueling bridge then moves the fuel assembly into the spent fuel storage racks. This process is reversed when fuel is loaded into the reactor.

As of July 2018

Boiling-Water Reactor Refueling

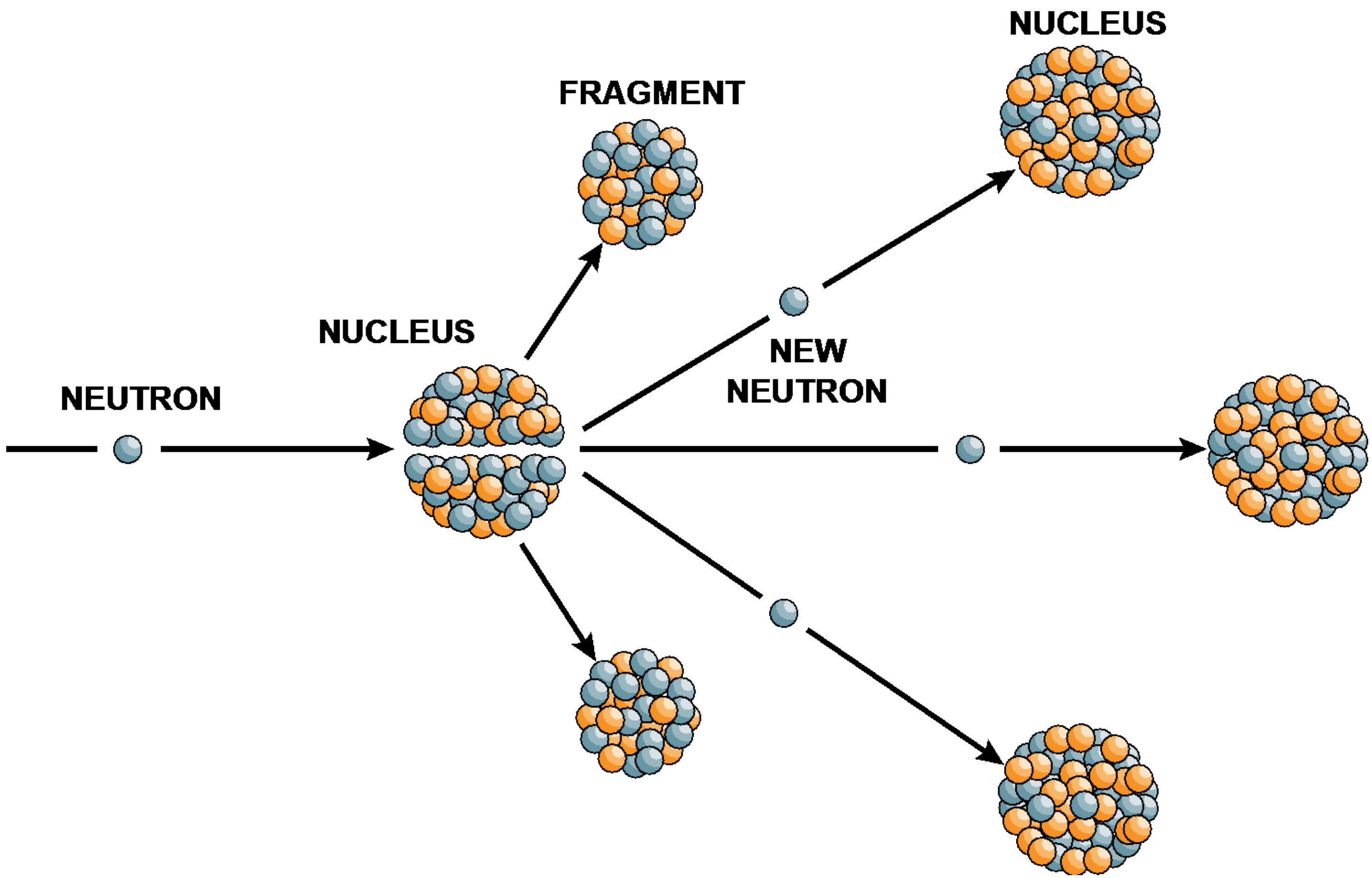


BWR Refueling Summary:

As new fuel shipping canisters arrive in the reactor building, the reactor building crane lifts them to the refueling floor, where the fuel is removed from the canister and inspected for defects. The fuel can then be stored in either the new fuel storage area (which is dry), or in the refueling pool, depending upon the needs of the site. Fuel in the new fuel storage area is moved into the fuel pool prior to refueling activities. To refuel the reactor, the containment vessel lid and the reactor vessel head are removed, the refueling cavity above the reactor vessel is flooded, and the gates between the reactor cavity and fuel pool are removed. The refueling bridge removes one fuel bundle at a time from the reactor and transfers it to the spent fuel storage racks until about a third of the fuel is removed. The process is reversed when fuel is removed from the fuel pool and placed in the reactor. In BWRs the fuel remains in a vertical position throughout the process.

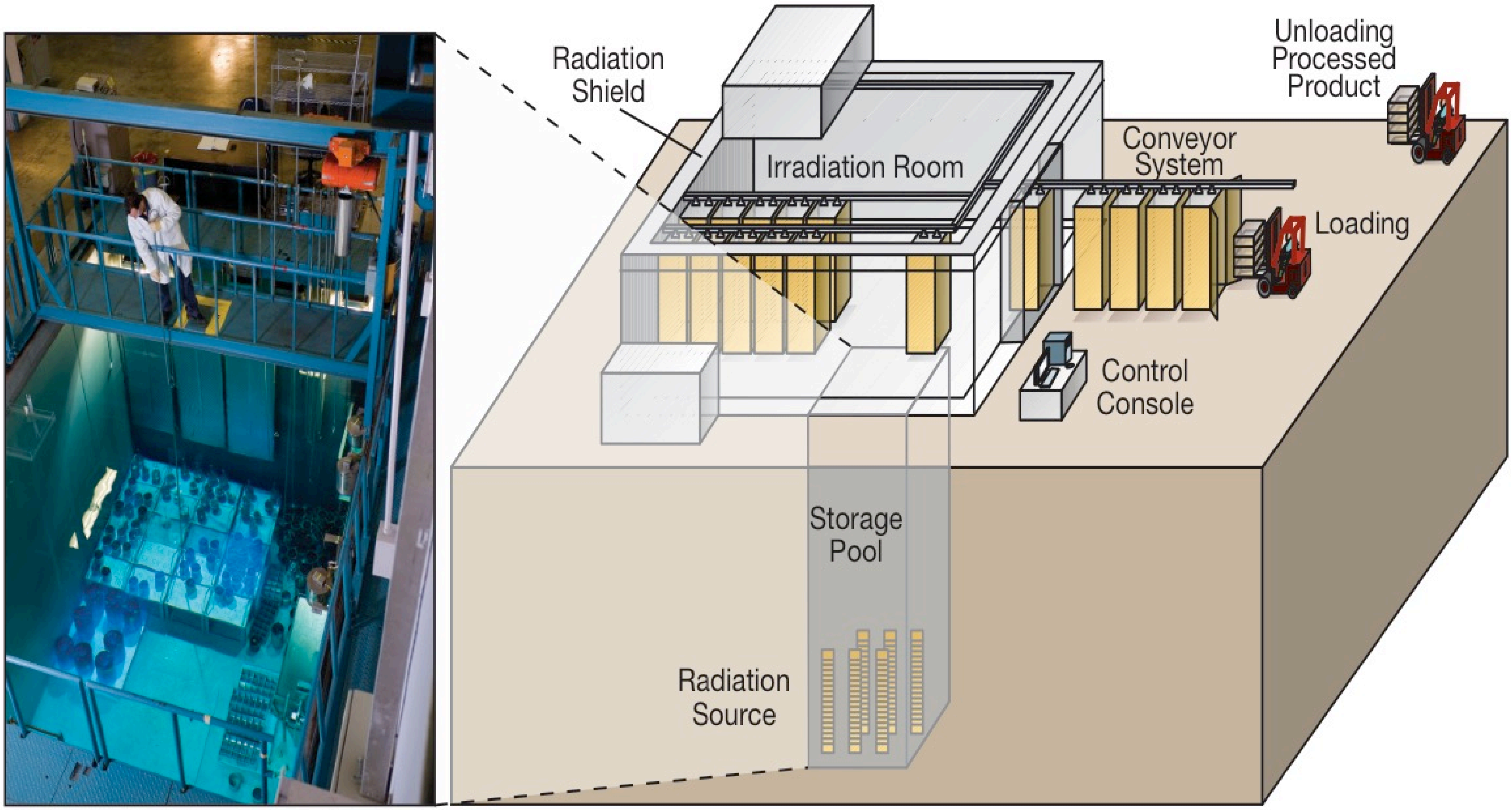
As of July 2018

Nuclear Reaction



As of July 2018

Commercial Irradiator

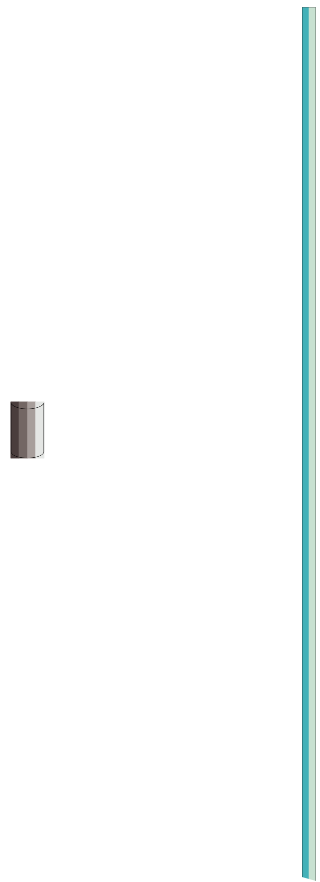


As of July 2018

Dry Cask Storage

As of July 2018

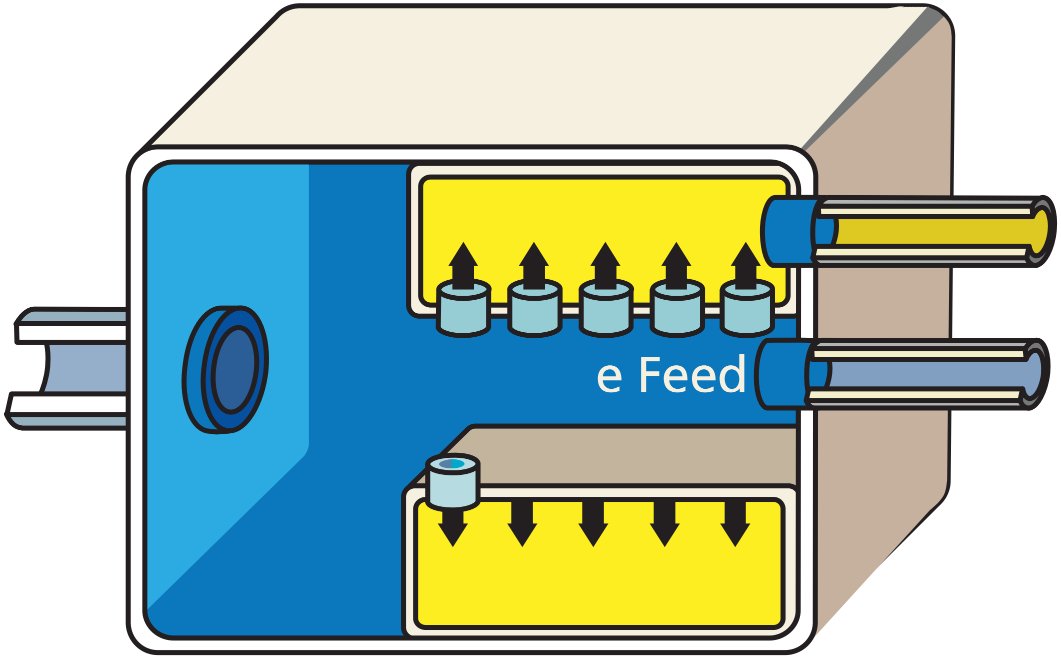
Fuel Assembly



Spent fuel assemblies, are typically 14 feet [4.3 meters] long and contain nearly 200 fuel rods for PWRs and 80–100 fuel rods for BWRs.

As of July 2018

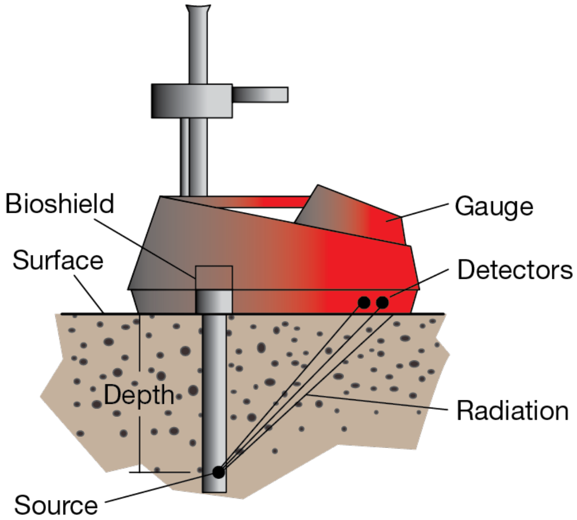
Gaseous Diffusion



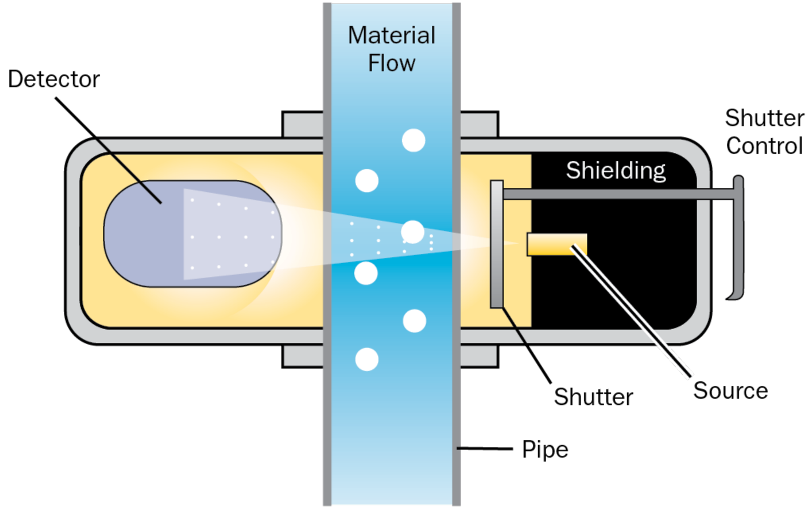
As of July 2018

Gauging Devices

Moisture Density Gauge

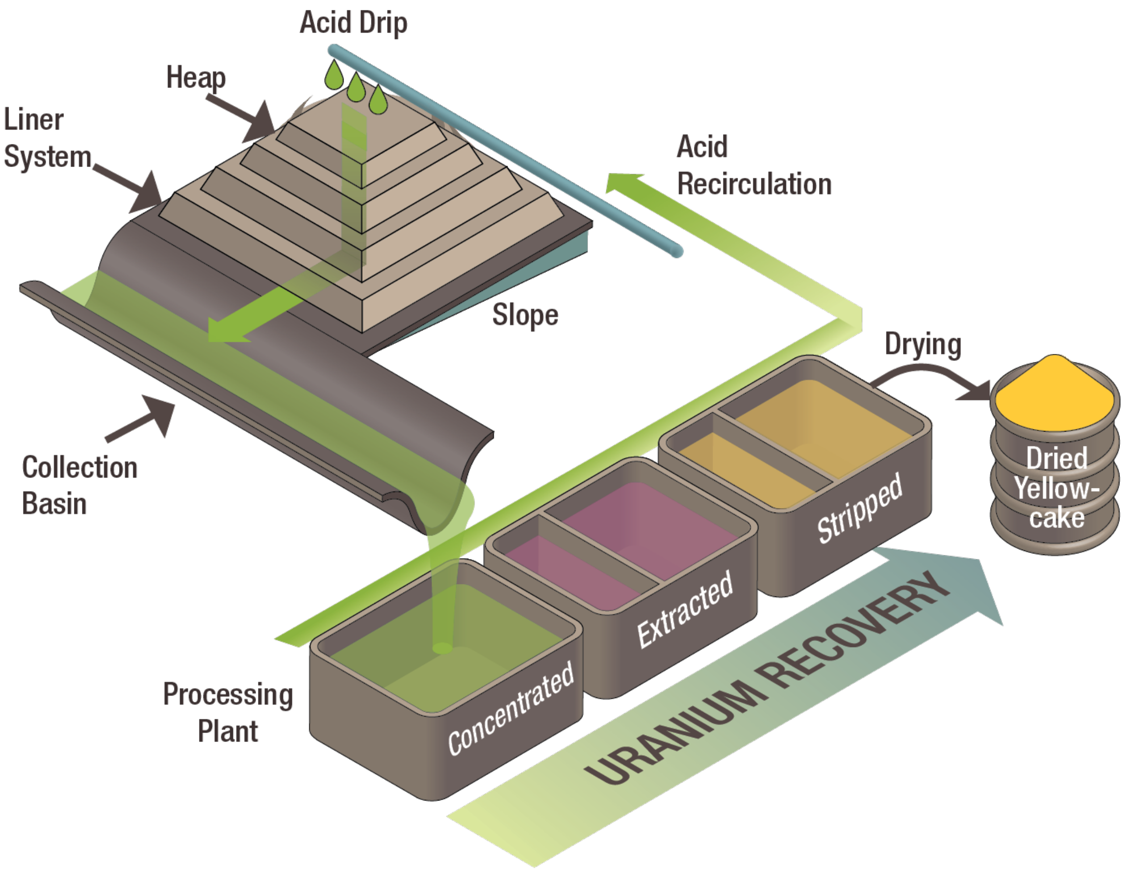


Fixed Fluid



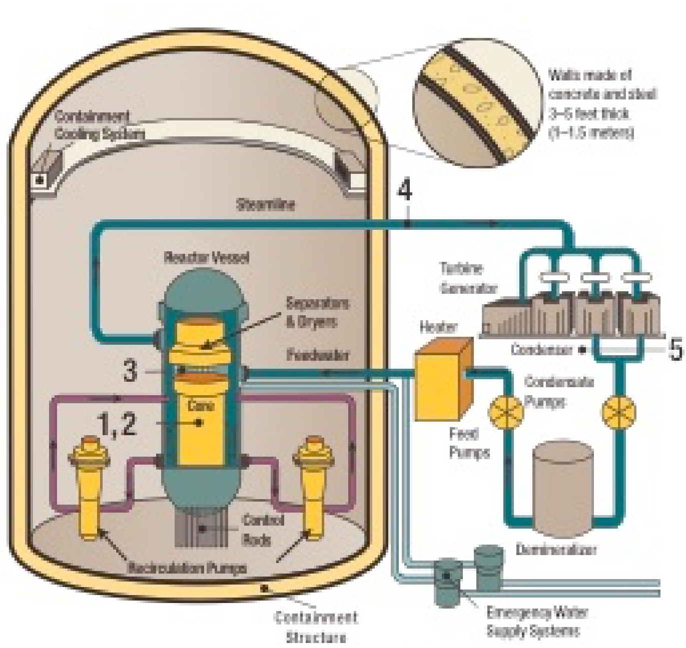
As of July 2018

Heap Leach Recovery Process



As of July 2018

A Typical Boiling-Water Reactor



How Nuclear Reactors Work

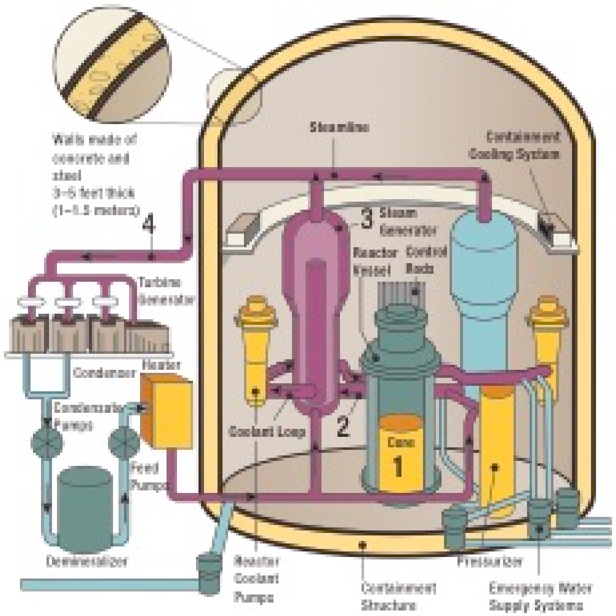
In a typical design concept of a commercial BWR, the following process occurs:

1. The nuclear fuel core inside the reactor vessel creates heat from nuclear fission.
2. A steam-water mixture is produced when very pure water (reactor coolant) moves upward through the core, absorbing heat.
3. The steam-water mixture leaves the top of the core and enters the two stages of moisture separation where water droplets are removed before the steam is allowed to enter the steamline.
4. The steam is piped to the main turbine, causing it to turn the turbine generator, which produces electricity.
5. The steam is exhausted to the condenser, where it is condensed into water. The resulting water is pumped out of the condenser with a series of pumps and pumped back to the reactor vessel.

The reactor's core contains fuel assemblies that are cooled by water circulated using electrically powered pumps. These pumps and other operating systems in the plant receive their power from the electrical grid. If offsite power is lost, cooling water is supplied by other pumps, which can be powered by onsite diesel generators or steam generated by the core. Other safety systems, such as the containment cooling system, also need electric power. BWRs contain between 370–800 fuel assemblies.

As of July 2018

A Typical Pressurized-Water Reactor



How Nuclear Reactors Work

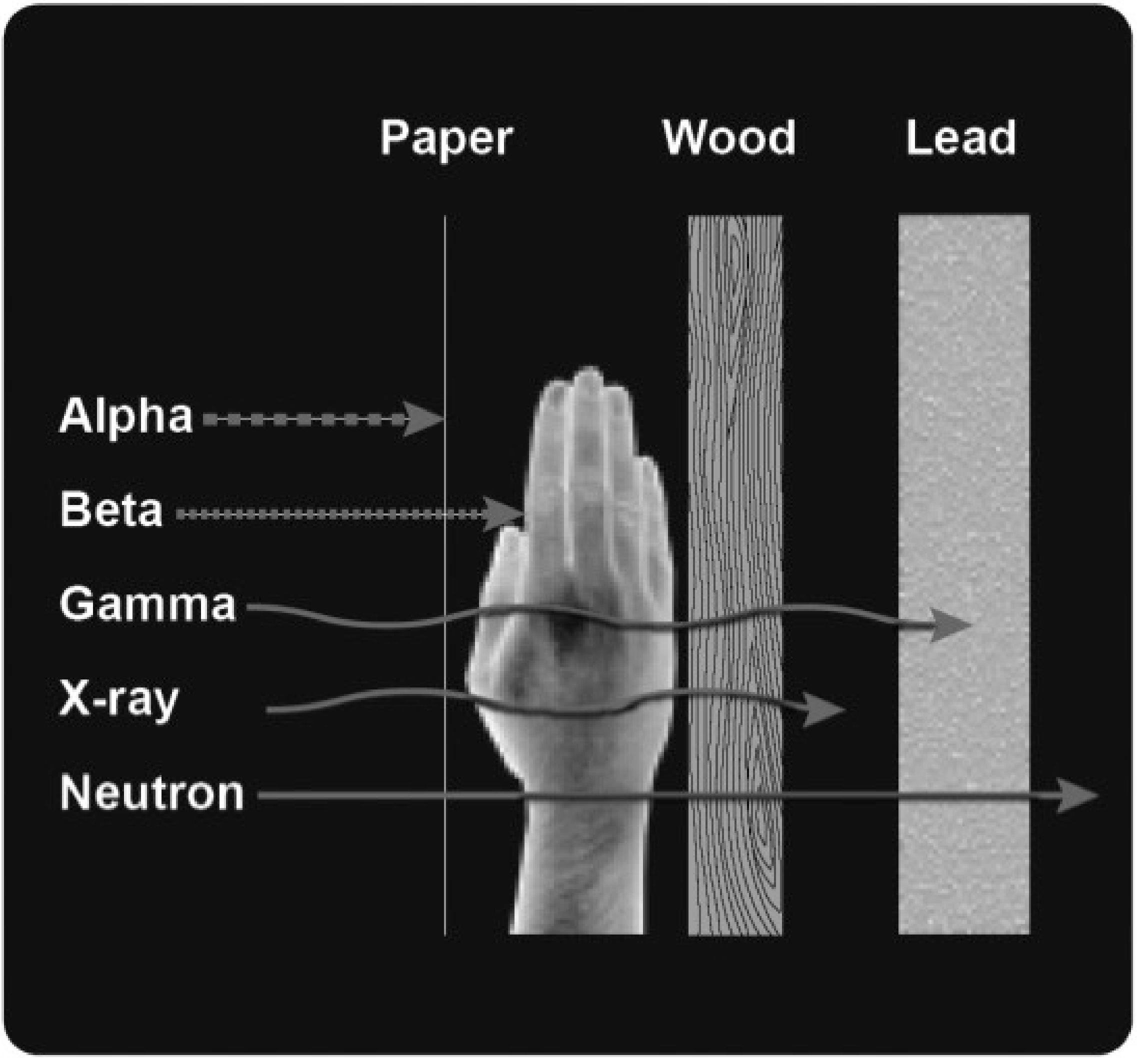
In a typical design concept of a commercial PWR, the following process occurs:

1. The core inside the reactor vessel creates heat.
2. Pressurized water in the primary coolant loop carries the heat to the steam generators.
3. Inside the steam generators, heat from the primary coolant loop vaporizes the water in a secondary loop, producing steam.
4. The steamline directs the steam to the main turbine, causing it to turn the turbine generators, which produces electricity.

The steam is exhausted to the condenser, where it is condensed into water. The resulting water is pumped out of the condenser with a series of pumps, reheated, and pumped back to the steam generators. The reactor's core contains fuel assemblies that are cooled by water circulated using electrically powered pumps. These pumps and other systems in the plant receive their power from the electrical grid. If offsite power is lost, cooling water is supplied by other pumps, which can be powered by onsite diesel generators. Other safety systems, such as the containment cooling system, also need electric power. PWRs contain between 120–200 fuel assemblies.

As of July 2018

Nuclear Radiation

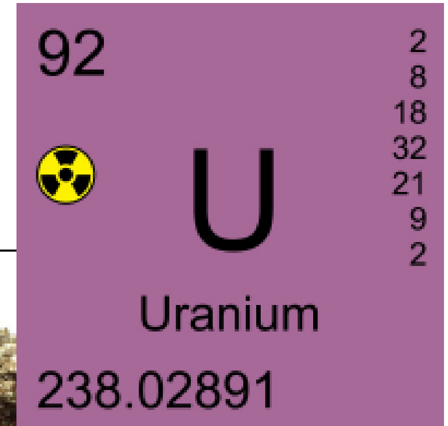


As of July 2018

Radiation Warning Symbol

As of July 2018

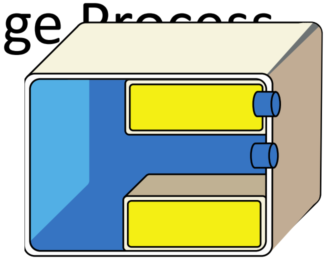
Uranium



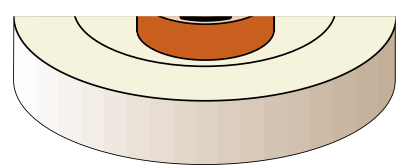
A piece of natural uranium ore

As of July 2018

Gas Centrifuge Process



entrifugal force. Heavier gas molecules move to the cylinder wall, while lighter molecules collect near the center. The stream, now slightly enriched, is fed into the next cylinder. The depleted stream is recycled back into the previous cylinder.



As of July 2018