# RADIOLOGICAL RECOVERY LOGISTICS TOOL

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## ABSTRACT

- Argonne is building and testing a tool, the **Radiological Recovery Logistics Tool (RRLT),** that can be used during the response and recovery from a radiological or nuclear incident to effectively allocate appropriate commercial and public works equipment to mitigate, remove, and contain radiological contamination. The requirements for this tool—as well as development of the resulting software—is overseen by a steering committee of stakeholders from DHS's National Urban Security Technology Laboratory (NUSTL), the Federal Emergency Management Agency (FEMA), and the Environmental Protection Agency (EPA).

- RRLT's Knowledge Base will contain information on the form of contamination, types of contaminated surfaces, affected facilities, and information on various types of municipal and commercial equipment assets that may be used to plan an expedited mitigation and remediation strategy.

- RRLT is driven by *use cases*. A use case is an intention with which a user approaches the software. Use cases are grouped into delivery increments to schedule development, testing, and presentation to stakeholders. This model partitions the system into seven increments: User Arrival and Authentication, Search and Navigation, Equipment Recommendation, Plan Management, Content Management, and Expanded Access. Once a user is authenticated, RRLT will present the user with a dashboard that allows them to explore or search RRLT's content. The dashboard will also include a "Plan" panel for collecting decisions and relevant observations about an incident at hand to facilitate development of an equipment list.

- RRLT will offer three general modes of access to items in the knowledge base:
  − Keyword search for direct discovery of items,
  − Navigation along predetermined paths from recovery goal towards equipment types, and
  − Interactive guidance towards equipment types by an autonomous software agent: the *Equipment Recommendation Wizard.*

## EQUIPMENT FOR RADIOLOGICAL RESPONSE AND RECOVERY

- Considers a wide area release of nuclear or radiological material such as nuclear plant accident, RDD, IND.
- Compressing the recovery timeline through the use of municipal and commercial equipment.
- We developed example missions or scenarios for five "Support Goals" that ask -
  - *What types of municipal and commercial equipment can be used to complete the scenario activity, and do we have sufficient data to recommend their use and predicted efficacy?*
- At this stage, we expect the following activities in the impacted area:
  − People, vehicles, and objects have moved and are moving in and out of the contaminated areas,
  − Urgent mitigation or remediation is needed for critical infrastructure (e.g., water utility, energy utility, transportation, medical, fire stations, government facilities, etc.),
  − Stakeholders are developing remediation strategies…

## SUPPORT GOALS

- **Survey and monitoring:** Monitor the radiological contamination levels in affected areas for an extended period.
- **Mitigation of received dose to first responders:** Reduce the radiation dose burden to response and recovery personnel.
- **Decontamination (gross and final):** Decontamination methods can be more effective if implemented within days of a release rather than waiting months or years.
- **Waste management:** Large amount of contaminated, solid waste will be generated over a wide area from businesses and residences.
- **Containment of wastewater:** Water will likely be used by first responders to extinguish fires that may be generated during a radioactive release. It may also be used to reduce radiation levels to early responders and subsequent response teams.

## SURVEY AND MONITORING

- Monitor the contamination levels in affected areas for an extended period to understand the dose to workers and residents.
- Assumes traditional survey monitoring equipment, such as TLD badges, portable survey monitors, gamma-ray spectrometers, are already in place.
- What types of municipal and commercial equipment can be used to enhance the survey and monitoring of contamination?
- Examples: air filters from garbage trucks and delivery trucks, personal cell phones.

## MITIGATION OF RECEIVED DOSE TO FIRST RESPONDERS

- Reduce the radiation dose to response personnel.
- What types of municipal and commercial equipment can be used to carry out gross decontamination and to contain and prevent the resuspension and tracking of contamination?
- Examples: Fireboats to knock down radioactivity levels near the shore; dump trucks and bobcats to spread mulch and gravel across roadways.

## DECONTAMINATION (GROSS & FINAL)

- Decontamination methods can be more effective if implemented within days of a release rather than waiting months or years for the contamination to evolve chemically and physically, rendering it more difficult to remove.
- What types of municipal and commercial equipment can be used to carry out gross or final decontamination of contaminated surfaces?
- Examples: Street sweepers to remove particles, asphalt-milling machines to remove the top layer of road surfaces, bobcats to remove the top layer of vegetation.

## EXAMPLE EQUIPMENT TABLE FOR EACH SUPPORT GOAL

| Scenario Description | Summary | Category | Equipment or Method Description | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Street sweeper | Large area pressure washing | Drain covers | Agricultural aircraft | Firefighting aircraft dumpers | Bambi buckets |
| Hard, horizontal surfaces such as roads, walkways, and parking lots can trap radioactive contamination. Prior studies and experience drew that contamination on paved surfaces can be effectively reduced by washing these surfaces with water-based solutions. What type of equipment can wash many linear miles of these paved surfaces and collect the washings? | Common unresolved issues are (1) Availability of privately owned equipment. It may already be in commercial or private use, or owners may be reluctant to allow its use in a radioactive environment without prior agreements in place. (2) Ability to decontaminate equipment afterward for unrestricted use.  Street sweepers are attractive options, but they were not designed to wash the street or collect very small particles. This makes their utility dubious. Studies are necessary to determine efficacy for urban decontamination.  With any method that employs water, controlling runoff (by diverting it from sewer inlets or covering grates) is important and difficult, especially when dumping thousands of gallons of water on an area. | EQUIPMENT | Used to clean dirt, mud, gravel, and small debris from roadways. | Specialty or ad hoc covers can protect sewer intakes. | Specialty or ad hoc covers can protect sewer intakes. | Crop dusters or top spreaders spread pesticides or fertilizers, respectively, over large tracts of land. | Designed to fight fires by deluging the area with water from a nearby water source. | Designed to fight fires by deluging the area with water gathered from a nearby water source. |
| | | DESCRIPTION | | | | | | |
| | | ADVANTAGES | Water or waterless vacuum sweeper. | 50 liters per minute, 1,650-liter tank. | Polyurethane, clay, or magnetic drain covers, or ad hoc (e.g., wood panel, poly-sheeting). | Large coverage rate, versatile aircraft. | Can treat large areas, large volumes (supermaker: 20,000 U.S. gallons). | Large volume capacity (up to 2600 gallons). |
| | | LIMITATIONS | Designed for sand and grit type debris, some units do not have HEPA filters. | Containment of wastewater, necessary to ensure water recycle can be needed. | Available COTS, Do-It-Yourself (DIY) guidance. | Amount of water sufficient for goal, containment of water, access to urban canyons. | Gross spreader, availability, containment of water. | Gross spreader, containment of water. |
| | | R&D NEEDS | Effectiveness on smaller fallout particles (BE, PE). Controlling factor (BE): Water recycle options (LR, BE, PE). | Survey of inventory (LR). Water collection options (LR). | Best practice guidance (LR). | Survey of inventory (local, regional, national, private, commercial) (LR). Controlling factors (BE). | Survey of inventory (local, regional, national, private, commercial) (LR). Controlling factors (BE). | Survey of inventory (local, regional, national, private, commercial) (LR). Controlling factors (BE). |

## CONTAINMENT OF WATER AND WASTEWATER

- Water will likely be used by first responders to extinguish fires that may be generated during a radioactive release.
- Water may also be used to reduce radiation levels to early responders and by subsequent response teams.
- How can water be collected or diverted for proper treatment and disposal?
- What types of equipment can be used to collect, contain, and transport liquid wastes?
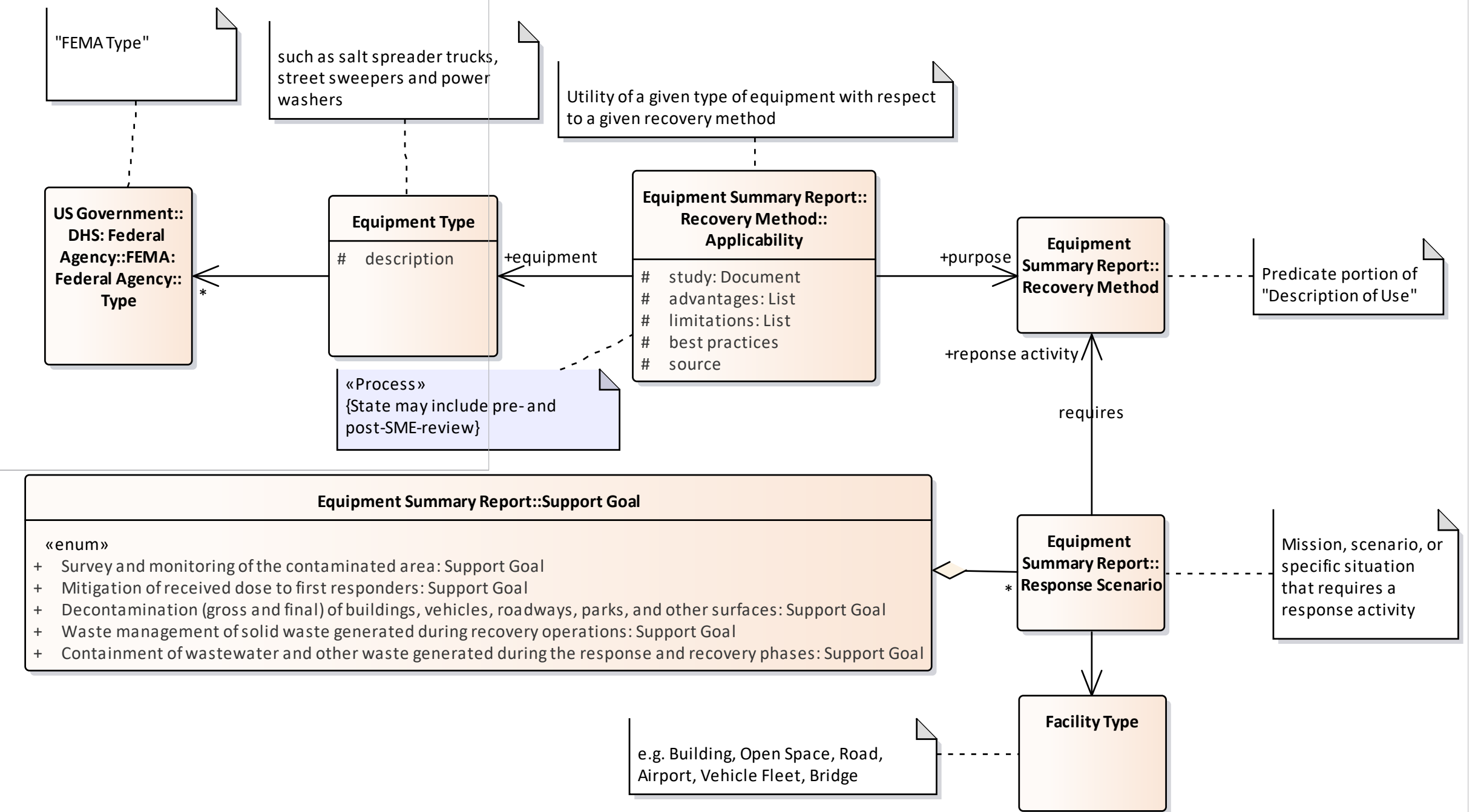  − Examples: portable tanks and storage bladders, barges, storm sewers, reservoirs.

## WASTE MANAGEMENT

- Contaminated solid waste will be generated over a wide area from businesses and residences.
- Solid radioactive waste should be collected for staging and disposal.
- What types of municipal and commercial equipment can be used to stabilize, contain, store, and transport the radioactive solid waste generated during mitigation and decontamination operations?
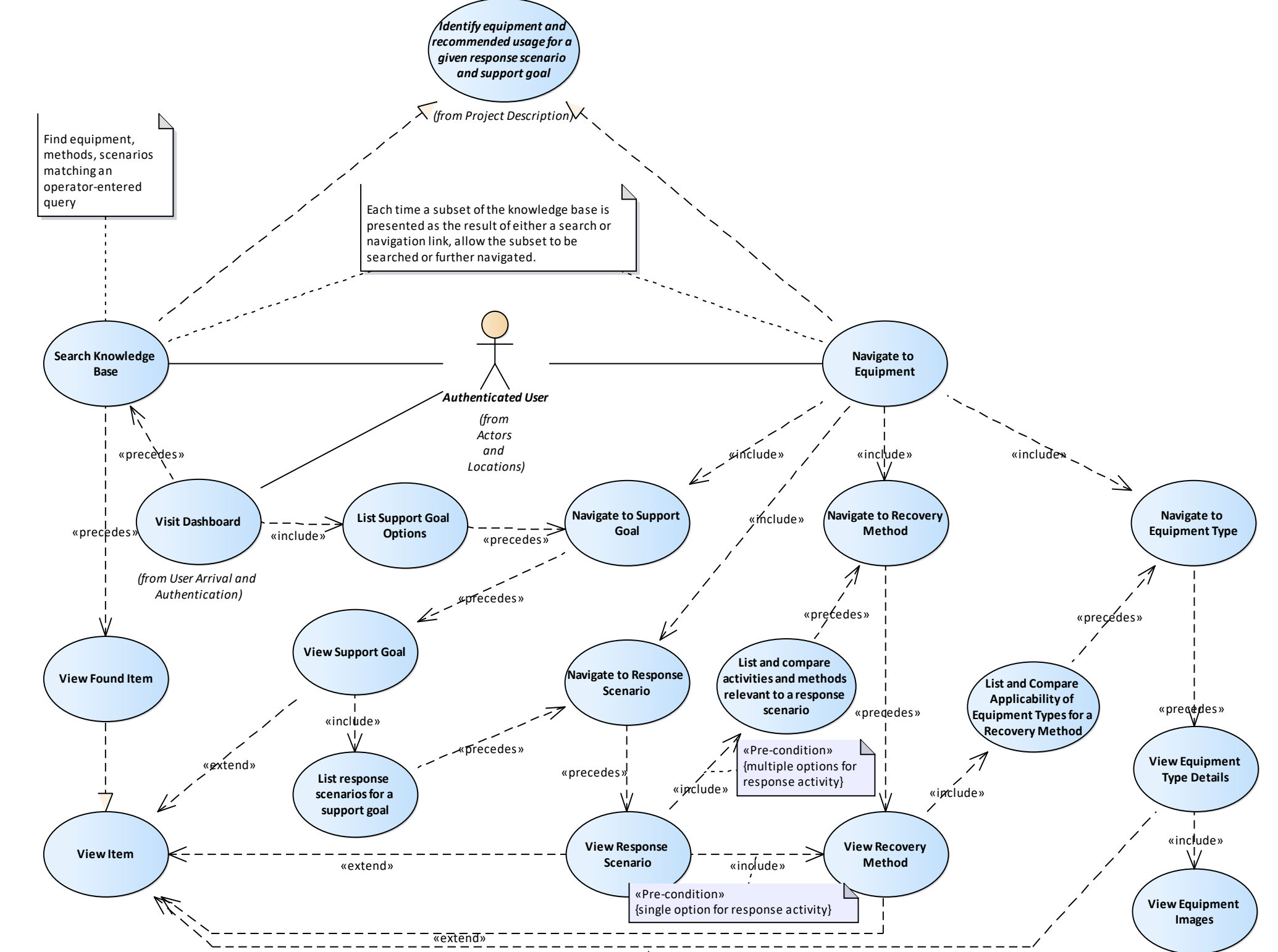- Example: Municipal waste garbage trucks to pick up garbage and collect in interim locations.

## THE MODEL

- RRLT's Knowledge Base will contain details on dozens of Equipment Types and facilitate the Operator's discovery and consumption of these details most pertinent to a dynamically selected subset of recovery scenarios—with the possible addition of environmental details about the incident for which recovery is being conducted.

- Equipment Type
  − The RRLT knowledge base groups equipment into types by form and function.
  − The equipment types are, in general, broadly encompassing of many specific pieces of equipment that would fall under the same category and will be linked to the FEMA Resource Typing Library Tool (RTLT) when possible.
  − It should be noted that some equipment options provided by the RRLT may not be associated with a Resource Typing ID—and other might be associated with multiple typing IDs.
  − The RRLT database of equipment is not limited to federally supported equipment options and may recommend equipment available through federal, regional, or local resources--or from non-governmental organizations, vendors, and stores.

- Facility Type
  − The facility type describes the structure, topographical feature category, surface, or specific facility that is impacted by contamination.
  − The intent is to alert the user that the tool contains specific information regarding a specific material or business function that may be useful to the stakeholder.



## SEARCH AND NAVIGATE

- Once authenticated, the operator will have access to a "Search" bar in a consistent location near the top of the viewport.
  − Users will be able to enter queries consisting of words, quoted phrases, Boolean combinations (AND, OR) of subqueries, and negated subqueries ("NOT" expressions).
  − When the operator submits a query, the system will respond by displaying a list of items matching that query: the search results.

- The appearance and behavior of search results will be consistent with that of lists of items arrived at by navigation and other means throughout the system.

- Each item will be represented by a listing that includes a hyperlinked label along with an icon indicating the type or category to which the item belongs (e.g. goal, scenario, equipment type).

- The default presentation of these listings will be rows sorted alphabetically by title.

- Clicking on the label or icon within a listing will cause the system to navigate forward to the complete content for that selected item.

- The appearance, structure, and behavior of an item's content will vary in accordance with the type of item being viewed.

- In general, the operator will be presented with the name or title of the item, a passage of text describing the item, any images associated with the item, and in most cases, links allowing for navigation to related items.

- RRLT offers a navigation hierarchy leading towards details on types of equipment listed in the system's knowledge base.



Municipal and Commercial Equipment for Radiological Response and Recovery in an Urban Environment: State of Science, Research Needs, and Evaluation of Implementation Towards Critical Infrastructure Resilience," Argonne National Laboratory Report, ANL/NE-35-17, 2018.

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