MULTI-ATTRIBUTE SCORING, RANKING AND SEQUENCING PROCESS FOR FACILITY D&D

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ABSTRACT

In 2003 the Savannah River Site conducted a significant information collection, database development and ranking and sequencing process for about 1,200 facilities targeted for disposition between now and 2025. The result was a comprehensive long-range facility disposition plan, Reference 1. This paper describes the information collected and the ranking and sequencing model developed to sequence the SRS facilities for disposition.

ACKNOWLEDGEMENT

The contributions of the many others who helped develop the plan, particularly John C. Devine, Jr., John P. Hayfield, Jr., and Steven E. Killoy of Polestar Applied Technology, Inc., and John C. Musall of Westinghouse Savannah River Co. are gratefully acknowledged.

INTRODUCTION

The SRS Integrated D&D Plan Database contains information on over four thousand facilities at SRS. The Ranking and Sequencing Model (RSM) is an application contained in this MS Access relational database performs model calculations that are used to help develop an optimized schedule. Because there are a large number of diverse facilities being considered for disposition at SRS, it is valuable to have a mechanized process for scoring and ranking the facilities, and making an initial sequencing that reflects their relative priority. Figure 1 illustrates the Ranking and Sequencing Process.

FACILITY DATABASE

Many of the excess facilities were older buildings that had ceased operation decades ago, and there was relatively little current information on these facilities. A program was initiated to go to the field and collect baseline information that would support the selection of an appropriate end state, and the planning and sequencing their ultimate disposition. The necessary information included building size, history of contamination, organizational responsibility, style of construction, physical condition, annual costs, and proximity to the public or watershed. Through most of FY 2002 a team of field engineers collected, analyzed and documented this information.

The following base facility information fields are contained in the database:

- Facility Number (Old and New)
- Facility Name
- Description
- Responsible Organization
- Facility Custodian
- Location (i.e. Grid and Site Map Coordinates)
- Square Feet of Working Area
- Style
- Structure Type
- Annual S&M costs
- Status
- Year Mission End Date
- Condition
- End State
- Duration
- ROM (Rough-Order-of-Magnitude) Cost and associated factors
- Present Value Cost-Benefit Ratio (PVR) – Calculated from financial data.

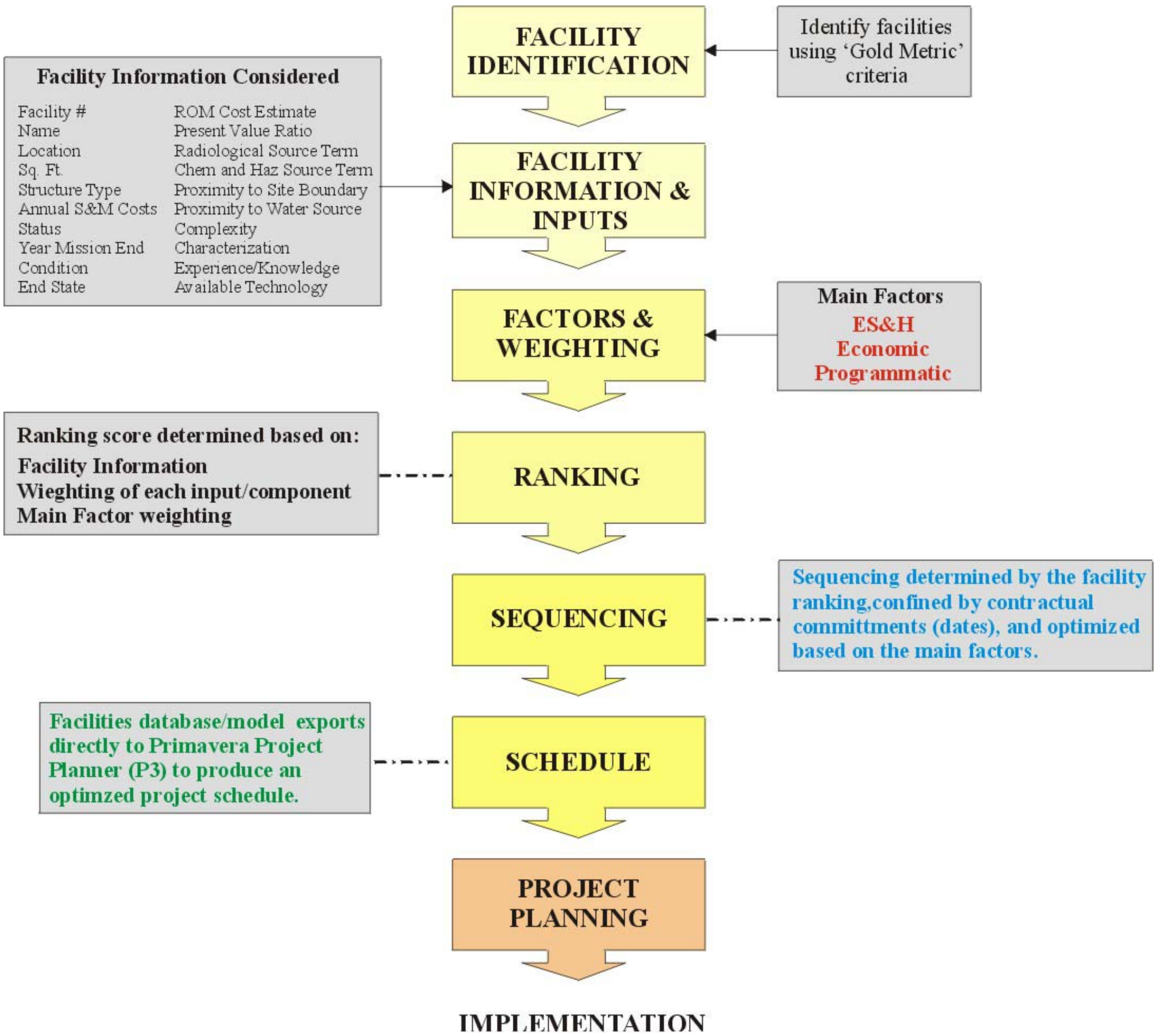

Fig. 1 Facility ranking and sequencing process

There are a variety of factors that influence the ranking and subsequent sequencing decisions that are taken into account in the Ranking and Sequencing Model (RSM), ultimately producing an optimized facility schedule. These include both base facility information and factors that involve subjective and objective information or evaluations.

Inputs include:

- Radiological Source Term
- Chemical and Hazardous Source Term
- Proximity to Site Boundary
- Proximity to Water Features
- Facility Condition
- Complexity
- Characterization
- Experience / Knowledge
- Available Technology

These inputs were organized into three main scoring parameters that are discussed in the following sections.

SCORING AND RANKING

There are many factors and inputs that affect ranking and sequencing decisions. The RSM combines these risk factors in three main parameters:

1) ES&H Risk
2) Economic Risk
3) Programmatic Risk

The inputs to each of these three main parameters are described below:

ES&H Risk (R_{ESH})

Environmental Safety & Health Risk (R_{ESH}) is the composite of health and safety risks posed by the facility, in its current condition, to workers, the public and the environment. The main inputs to ES&H Risk are:

- Radiological source term (Rad)
- Chemical or hazardous material source term (R_{CHM})
- Proximity to site boundary (P_{SB})
- Proximity to water source (P_{WS})
- Facility condition (F_{COND})

Economics / Cost benefit (R_{ECON})

Economic risk is expressed primarily in terms the Present Value Cost-Benefit Ratio (PVR). The PVR is a measure of the economic benefit of early disposition of the facility, compared to a prolonged period of surveillance and maintenance (S&M) followed by disposition. The PVR calculation uses 'net present value' (NPV) which takes into account time value of estimated cost vs. avoided costs (S&M plus facility repairs or upgrades). For the one of the building groups, a second factor based on a normalized ROM decommissioning estimate for the facility was also included in the scoring scheme to favor sequencing larger projects earlier in the process.

Building data for the PVR calculations is taken from the database and used in the calculations. The start year, end year, discount rate, escalation rate and degradation rate are taken from user entries at the time the model is run.

Programmatic Risk(R_{PROG})

Programmatic Risk **(R_{PROG})** is a measure of the confidence that the work can be performed as planned, and within the cost and schedule projections. Programmatic risk components are:

- Complexity ($F_{complex}$)
- Characterization (F_{char})
- Experience / Knowledge ($F_{E/K}$)
- Available Technology (F_{AT})

These three (3) main risk factors are estimated using the inputs described below:

INPUTS TO MAIN SCORING PARAMETERS

nputs used to calculate each risk factor were derived using base facility information from the ROM estimating data developed by the responsible engineers during facility walkdowns, information obtained from facility owners and custodians, and data obtained from the SRS Site Structure Database (SSSD). Values for the following inputs were determined and entered into the FDD database for each facility:

Information obtained from facility walkdowns and background research includes the following:

- Contamination
    - Radiological (Alpha, Beta/Gamma)
    - Hazardous/Chemical (Asbestos, Chemical)
- Characterization
    - The portion of the facility has requires characterization and the difficulty associated with that characterization
- Complexity
    - The complexity of the structure and systems it contains for purposes of dismantlement and demolition
- Condition
    - Determination of the condition of the facility

The following factors were determined from GIS analysis using site coordinates for each facility:

- Proximity to Public
    - Location of facility relative to the site boundary
- Proximity to Water Source
    - Location of the facility relative to a surface water body

The remaining factors were subjectively determined by facility subject matter experts (SMEs):

- Experience/Knowledge
    - Experience-based planning and knowledgeable, experienced work force lead to highly predictable job performance.
- Available Technology
    - Proven technology, methodology and resources must be sufficiently available to support smooth, predictable job performance

Within each of the three main scoring parameters, the above-listed components are combined to achieve a composite score, normalized to a range of 0-10, using scoring schemes with parameter combinations and weights defined by the user.

Radiological Contamination (R_{RAD})

The radiological (R_{RAD}) factor comprises a determination of the level of alpha, beta, and gamma contamination, as a percentage of the square footage, ranged as low, medium, or high for each type of contamination, in the ROM estimating methodology. These percentages were then combined in the ROM estimate calculations to produce an overall radiological source term value, which was imported directly into the facility database and normalized.

The R_{RAD} calculation to determine the radiological source term factor in the ROM Cost estimating methodology is presented below: The R_{RAD} value is a combination of the alpha (Alpfactor), and the beta/gamma (BGFactor) factors:

*AlpFactor = (AlphaHiPct*3+AlphaAvgPct*2.2+AlphaLoPct*1.7+AlphaNAPct)*
*BGFactor = (BGHiPct*2.2.+BGAvgPct*1.7+BGLowPct*1.3+BGNAPct)*

The various "Alpha_Pct" and "BG_Pct" variables are entries by engineers based on the facility walkdown of the percent of the floor area for each facility that falls into the HI, Avg, Lo and NA contamination categories.

Chemical or Hazardous Contamination (R_{CHEM})

Chemical or hazardous material factor comprised a determination of the level of chemical or hazardous material in a facility, as a percentage of square footage, ranged as low, medium, or high for each type of contamination, in the ROM estimating methodology. These percentages were then combined in the ROM estimate calculations to produce an overall hazardous material value, which was imported directly into the facility database and normalized.

The R_{CHEM} calculation to determine the chemical and hazardous material factor in the ROM Cost estimating methodology is presented below: The R_{CHEM} value is a combination of the Hazardous factor (HazFactor) and the Asbestos factor. For the Asbestos factor, the economy of scale for a facility larger than 5,000 sq. ft. was included by using two expressions (L5KAsbFactor (i.e. Sq. Ft. <5,000) or G5KFactor (i.e sq. ft. >5,000)):

*HazFactor = (HazHiPct*1.4+HazAvgPct*1.3+HazLoPct + HazNAPct)*
*L5KAsbFactor = (AsbestosHiPct*2.6+AsbestosAvgPct*1.8+AsbestosLoPct + AsbestosLoPct)*
*G5KAsbFactor = (AsbestosHiPct*1.9+AsbestosAvgPct*1.4+AsbestosLoPct + AsbestosLoPct)*

Contamination Factor (CONT)

The contamination factor *(CONT)* is a combination of the (R_{RAD}) and (R_{CHEM}) factors, weighted equally (Note that the RSM database software allows the user to define different Scoring Schemes with different weights as appropriate):

Cont = [(Alpfactor*0.25)+(BGfactor*0.25)+(Hazfactor*0.25)+(Asbfactor*.0.25)]

Facility Condition (FC)

The facility condition factor comprised a subjective determination of the structural condition of the facility by the field engineer. Five (5) main categories were used: Poor, Adequate, Fair, Good, or Excellent. Each condition category was assigned a value from 0-10, per the Table II.

Table II Facility condition values table

Condition	Score
Poor	8
Fair	6
Adequate	4
Good	2
Excellent	0

Complexity ($F_{complexity}$)

These complexity values ($F_{complexity}$) were subjectively determined by field engineers from walkdown of the facilities and by photographs and experience in some cases. The complexity value is a percentage of square footage, ranged as low, medium, or high, equaling 100%, as entered to produce the ROM estimate. These percentages (values) are combined in the ROM estimate calculations to produce an overall complexity factor value normalized from 0-10. Increase complexity translates into more difficult work and higher risk, resulting in a higher value.

The facility complexity equation in the ROM estimating database is as follows:

$$(F_{complexity}) = (SysHiPct*2+SysAvgPct*1.4+SysLoPct + HazNAPct) \quad \text{(Eq. 1)}$$

The following criteria were used to estimate percentages for each facility:

- Equipment – height and reach greater than 30 ft.
- Size and Quantity – Mass of Steel
- Concrete size and thickness greater than 18 inches
- Amount of contamination, both chemical and radiological in systems and components.
- Structure construction configuration and accessibility
- End State Determination (i.e. in-situ disposal could lower the complexity and systems may not be entirely removed.
- Structure type: Basin, Tower, Tank, facility, Piping system, etc.

Characterization ($F_{characterization}$)

The characterization value ($F_{characterization}$) of a facility entered as a percentage, based on the estimated level of characterization required to decommission the facility. This is, in large measure, and assessment of the current knowledge of contamination levels in the facility. The characterization value is used in the ROM estimate calculation.

$$(F_{characterization}) = (CharHiPct*1.5+CharAvgPct*1.4+CharLoPct*1.3+CharNAPct) \quad \text{(Eq. 2)}$$

A facility requiring extensive characterization would have a value from 8-10, where as a facility requiring no characterization would receive a value of 0-1. Table III below shows how these subjective values would range.

Table III Characterization values

Characterization Required	Value
Extensive	8-10
Moderate	6-8
Partial	4-6
Limited	2-4
Little to None	0-2

Proximity to Site Boundary (P_{SB})

The Proximity (P_{SB}) to Site Boundary input/component is a normalized measure of the distance to the site boundary. Facilities closest to the boundaries of the site would receive a higher value and facilities geographically situated near the center of the site would receive a lower value. This scoring is consistent with the site vision to create a buffer zone between the public and core operations near the center of the site. The $P_{SB\ value}$ was obtained using SRS site GIS data. The highest and lowest distances defined the range, which was normalized to a scale of 0-10.

Proximity to Water Source (P_{WS})

The proximity to surface water source (i.e. surface water only, not underground plumes) factor (P_{WS}) was obtained using SRS site GIS data for streams and ponds/lakes. The highest and lowest distances determined the range, which was normalized to a 0-10 scale.

Experience/Knowledge ($F_{E/K}$)

The experience and knowledge factor is determined by assessing the experience and knowledge currently available to decommission each facility. Construction type, contamination levels, complexity, and other factors are considered in the determination of this value. A facility constructed of typical construction materials, with little or no contamination would receive a relatively low value (0-3). A facility with thick concrete walls, containing many floors, high complexity, and high levels of contamination combined with a lack of onsite personnel who are experienced in decommissioning these types of facilities, would receive a value greater than 5 and up to 10. If onsite personnel have the experience and knowledge to decommission a highly complex or average administration or warehouse type of building then the value would be less than 5 to one (1) if the knowledge and experience is immediately available. Table IV shows these values.

Table IV Experience and knowledge criteria

Experience and Knowledge	
Criteria	**Range**
Little/no contamination, butler construction, low complexity	9-10
Some to moderate contamination, basic construction (some complexity)	6-8
Medium to high contamination levels, concrete and steel construction, medium to high complexity	3-5
Thick concrete walls, extensive piping, heavily contaminated	0-2

Available Technology (F_{AT})

The available technology factor (F_{AT}) was assessed by evaluating whether existing technology (equipment or process), currently available onsite, was adequate to deactivate or decommission the facility, within reasonable budget and schedule constraints. If the technology was immediately available (onsite), then the facility would receive a value of 0. If the technology had not yet been developed the value would be 9-10. If current instrumentation and equipment (onsite) was not adequate for the project, however, the technology (i.e. equipment, instrumentation, etc.) can be obtained, and then the value would range from 0-9, depending on cost and the ability of the technology to assist in decommissioning. If current technologies can be used for the facility, then the values range from 5-8. The proposed end state is important in the determination of the value of this input. Table V shows the range of values

Table V Available technology criteria

Available Technology (Equipment and Processes)	
Criteria	**Range**
Technology is in development or has not yet been developed	0-2
Current technology is available however is too costly, not cost effective, or process not efficient on the needed scale	3-5
Technology is available for purchase (cost benefit is realistic) and has been proven cost effective.	6-8
Technology is immediately available onsite and has prior use and experience	9-10

Present Value Cost-Benefit Ratio

Present Value Cost-Benefit Ratio (PVR) is a measure of the economic benefit of early disposition of a facility, compared to a prolonged period of S&M followed by disposition. The PVR is calculated, for each facility, using the following method.

The numerator of the PVR is the sum of the present value of the future D&D cost plus the present value of the S&M costs, and any other fixed (i.e. roof replacement) and/or escalating costs for each year, from the start year defined in the Model (or the year the facility first becomes available for disposition, whichever is later) to the end year defined in the Model. This quantity represents a scenario where disposition is assumed to be postponed to the latest possible date and includes the present value of all the costs to maintain the facility, and ultimately dispose of at the end date in the Model (i.e. 2025).

The denominator is the present value of the facility's ROM cost estimate at the year when the facility first becomes available for disposition, representing the scenario assuming immediate disposition to the facility end state as soon as the facility becomes available.

$$PVR = \frac{\text{Present Value of Future D\&D plus S\&M Costs for Each Year}}{\text{Present Value of ROM cost date the facility is first available for disposition}}$$

If a facility's PVR is >1, then it is advantageous to complete final disposition at the earliest possible date. If the PVR is <1, then it is not advantageous to decommission the facility early.

In performing these present value calculations the parameters typically used were: Interest Rate 6% per year, Inflation Rate 3% per year, and Degradation 5% per year. These values are user defined and can be modified for different cases as desired.

ROM Factor

For some building groups another parameter called the "ROM factor" is included in the economics parameter in addition to the PVR. The ROM factor is used to incentivize the completion of higher value projects. The ROM factor is determined by using the ROM estimate for the facility, divided by the maximum of the ROM estimates to normalize all ROM factors between 0 and 10:

$$\text{ROM Factor} = \frac{\text{ROM Disposition Cost for a specific facility}}{\text{Max ROM Cost of all facilities}} * (10)$$

DURATION

Development of Categories and Typical Durations

As a means of assessing the overall time frames for the SRS closure work, duration templates were established for the various types of facilities being dispositioned. The duration template value was determined by estimating the interval for each of the major steps in the decommissioning process and adding these durations, with consideration for parallel activities to obtain an overall typical duration for the project/facility. Sixteen duration categories were defined based on the end state, facility type, and size.

Assignment of Durations to facilities

Durations divisions were developed based on the facility type (i.e. hazard category), proposed end state (Demolish or In-Situ Disposal), and the size of the facility (i.e. sq. ft.). A facility <50,000 sq. ft in size, is categorized as 'small.' A 'large' facility is >50,000 sq. ft.

For facility categories lower than Radiological, it was assumed that the determination of action and conceptual planning and engineering would be combined with other facilities into a single project; therefore the initial two phases were omitted and assumed that the determination would be accomplished independently and collectively prior to detailed planning and engineering.

Facilities with a low ROM estimated cost (<$50K), regardless of size, were assigned a minimum duration of four (4) months. Although the actual time to demolish a small facility is a month or less, there would be planning, budgeting, subcontracts, and other preparation efforts required as part of a larger or related facility or project. The cost of these projects is therefore distributed over a longer time period. The scheduled date assumes the two initial phases have been previously completed. Table VI displays the results of the composite of each phase of the work for a given facility end state.

Table VI End state estimated durations

End State Project Durations	Duration (months)
Demolition Large Nuclear Category 2	57
Demolition Small Nuclear Category 2	45
In Situ Disposal Large Nuclear Category 2	41
In Situ Disposal Small Nuclear Category 2	37
Demolition Large Nuclear Category 3	47
In Situ Disposal Large Nuclear Category 3	39
Demolition Small Nuclear Category 3	35
In Situ Disposal Small Nuclear Category 3	32
Demolition Large Radiological	40
Demolition Small Radiological	25
Demolition Large Chemical/Industrial	23
Demolition Small Chemical/Industrial	15
Demolition Large Never Contaminated	12
Demolition Small Never Contaminated	8
Facility (<$50K ROM) – Large	4*
Facility (<$50K ROM) – Small	4*
**Minimum project duration*	

END STATE DETERMINATION

The end state is the status of a unit (i.e. facility, waste site, tank, etc.) after decommissioning and closure activities are complete.

End State Alternatives

Two decommissioning end state alternatives exist for facilities: Demolish and In-Situ Disposal (also referred to as In-Place Closure (IPC)).

Demolish

In this end state the entire facility is demolished and removed to grade, and decontaminated as necessary to meet established release criteria. There may be variations among individual residual conditions within this end state category. For example, some facilities may be removed in their entirety, while the sub-surface portions of others may remain in place after decontamination and removal of hazardous materials. In all cases, the end state must be compliant with applicable regulations and with the goal of no new waste sites created at SRS.

In-Situ Disposal

Second, the facility can be decommissioned to a condition considered "In-Situ Disposal (ISD), also commonly known as 'in-place closure" (IPC). In this condition, the facility is either left in a structurally stable condition (i.e., hardened structures such as reactor or canyon buildings), or contaminants are stabilized and barriers put in place to ensure the contaminants cannot be disturbed or mobilized such as a land fill. In this condition, the remaining site, if left undisturbed presents no remaining threat to the public or the environment, but is not available for reuse of any kind due to the nature of the site and protection of the installed barriers. In this condition, it is common to require post- decommissioning monitoring for a period of time to ensure that no mobilization of the known contaminants is occurring and that the engineered barriers that have been installed are functioning as designed. The key factors to determine this end state are:

- The unit must be suitable or can be made suitable for permanence. In this case, facilities considered hardened structures that are structurally sound, or sites where the contaminants could be stabilized sufficiently such as contaminated basins and engineered barriers/environmental caps placed over the stabilized site would be candidates for this end state.
- Location is suitable. Site location is critical for this end state to be viable. For contaminated facilities located near site boundaries (i.e., adjacent to public access areas), or located where contaminant migration could impact underground aquifers or surface water, this end state would not be desirable.
- Government and stakeholders accept the end state. Aside from the issues presented in the previous two bullets, political issues/concerns related to in-place closure of the unit may prevent this end state being selected.

Safe Storage and Deactivation are interim options in a facility's lifecycle prior to completion of the final end state. The end state decision is very important in the planning process since it defines the extent of facility decommissioning and site remediation and factors heavily into the cost, schedule, and work scope of the decommissioning project.

End State Determination Process

When a facility, structure, or in-ground storage tank is identified as excess, the first step is to define the final end state for the unit. It is important to determine this end state early, as the final end state will dictate what steps must be taken to safely mitigate hazards, stabilize or remove contamination and ultimately disposition the facility. These factors will affect both cost and schedule for completion of the project, and will also play a major role in determining the appropriate timing and sequencing with other decommissioning actions considering that there are limited fiscal funds and competing site priorities.

The following series of questions must all be answered in the affirmative to select the In-Place Closure end state; otherwise the Demolition end state will be selected.

No commitments exist to achieve another End State, AND
Physical facility is or could be rendered suitable for permanence, AND
Location is acceptable for IPC, AND
Life-cycle cost of IPC is less than other End States, AND
All regulatory /legal requirements can be met by IPC, AND
Remaining radiological, chemical, environmental risks in final IPC End State are acceptable, AND
Government and Stakeholders accept the IPC End State.

ROM (ROUGH-ORDER-OF-MAGNITUDE) COST ESTIMATE

ROM estimates were developed for each facility. Developing a facility ROM estimate is done in the following process:

1. Determining base facility D&D unit cost
2. Apply site correction factors and current year inflation to base unit costs
3. Develop ROM factors for each facility
4. If the facility End State is In Place Closure, then reduce the calculated ROM by half.
5. If facility specific information warrants, override the calculated ROM with a facility-specific value

The facility D&D estimates in the SRS ROM model are based on historic INEEL costs, broken down according to facility size. The base case is assumed to be the cost to decommission a clean, reinforced concrete building to its end state. For the demolish end state, the slab or foundation is left; for In Place Closure end state, the remaining portion are immobilized with grout or concrete. The ROM estimating model does not account for deactivation, personnel relocation or other assorted costs, and only include very limited waste disposal costs.

A variety of completed INEEL demolition projects from 1994 to 2000 were analyzed to arrive at a base D&D rate. The data gathered covers the full range of demolition project activities, including characterization, planning, mobilization, sampling and analysis, asbestos removal, demolition, project management, demobilization, and final reports. These INEEL data were used to establish initial SRS facility base rates.

Applying Site Correction Factors

The Site correction factor is a multiplier applied to the base INEEL D&D rates discussed above. This factor is used to correct the baseline D&D rate used from another site for differences in labor rates, labor practices, efficiencies, accounting systems, or others and based on a comparison on rates in FY2000. The SRS site correction factor, calculated at 1.2, is based on the average of SRS overhead burdened exempt and non-exempt labor rates divided by the INEEL composite labor rate. As the correction factor is a multiplier to the base D&D rate, it affects the ROM decommissioning cost estimates for all SRS facilities and decommissioning.

Table IX Base D&D rates

Facility Square Footage	**Decommissioning Rate (DR) ($/SF)***
500 – 1000	$73.73
1001 – 5000	$52.77
> 5000	$41.91

**The INEEL rates were modified to SRS rates and inflated to 2003 dollars.*

Developing ROM Factors for Each facility

Once a base D&D rate is established, numeric ROM percentage factors corresponding to low, average, and high facility hazards are applied. ROM factors raise or lower the cost estimate to account for presence or absence of hazards, as follows:

- Asbestos – The relative level of asbestos contamination in the facility
- Beta/Gamma Radiological – The relative level of β-γ radiation contamination in the facility
- Alpha Radiological – The relative level of ά radiation contamination in the facility
- Hazardous – The relative level of hazardous chemical contamination in the facility

Additional adjustments are applied to take into account other factors affecting decommissioning costs, as follows:

- Characterization – The level of characterization necessary needed prior to D&D
- Systems – The relative level of system complexity in the building
- Facility Type – The type of material used in construction of the facility; metal concrete, wood, etc.
- End State – Demolish or In-Situ Disposal

Table X shows the ROM factors utilized in the SRS model.

Table X ROM estimate factors

Factor	Calculation Name	High	Average	Low
Asbestos < 5000 ft^2	AsbFactor	2.6	1.8	1.0
Asbestos > 5000 ft^2		1.9	1.4	1.0
Beta/Gamma	BGFactor	2.2	1.7	1.3
Alpha	AlpFactor	3.0	2.2	1.7
Hazardous	HazFactor	1.4	1.3	1.0
Characterization	CharFactor	1.5	1.4	1.3
Systems	ComplexFactor	2.0	1.4	1.3
Facility Const. Type	ConstructionFactor	**Concrete**	**Steel**	**Misc.**
		1.0	0.8	0.5
End State	ESFactor	**Demolish**	**In-Situ Disposal**	**N/A**
		1.0	0.5	**N/A**

ROM Cost Calculation(s)

Estimates for each Category (High, Average, and Low) are made by SMEs for the facilities, based on facility walkdowns. A ROM worksheet was developed in the database to assist the user in calculating the ROM estimate for a facility.

Calculations for asbestos, beta/gamma, alpha, and hazardous, system complexity, and characterization factors were described above.

Facility Construction type calculation is handled as follows:

*Construction Factor = (ConstrConcrete + ConstSteel * 0.8 + ConstOther * 0.5)*

Each of the factors listed in Table X are combined to produce the final ROM estimate using the base rates for facility square footage provided in Table IX.

Final ROM Estimate Calculation

FinalROMCost = [(DR * Sq. Ft. * Asbfactor * HazFactor * Beta/Gamma Factor * Alpha Factor * Complexfactor * Characterizationfactor * (ConstFactor/1000)) * 1000] * ESFactor

When the In Place Closure End State is selected for a facility, the calculated ROM estimate is reduced by half to reflect the reduced scope to close the facility in place.

The ROM estimate is used for the facility disposition cost in the Ranking and Sequencing Model unless the user overrides with a facility-specific estimate.

RANKING & SEQUENCING (RSM) METHODOLOGY

The RSM employs methodology similar to those using multi-attribute decision analysis techniques and involves determining the relative weight of each criterion, and establishing a protocol for scoring each candidate action against each criterion. Within that framework, each closure project is evaluated and scored, composite weighted scores are compiled and the results are tabulated and compared. The model produces a ranking and sequencing of facilities that is exported to Primavera Project Planner (P3) to support accelerated schedule development. Subsequent sensitivity studies, case runs, and consideration of work efficiencies, visual skyline reduction, or other considerations are conducted as necessary to produce a final schedule.

Building Groups

The model allows facilities to be grouped into specific Building Groups. Building required to be completed in the near term under the SRS contract were assigned to Groups 1 (Threshold) and 2 (Target). Table VII shows the building groups that were used in the SRS model:

Table VII Building groups

Building Groups	
Group No.	Description
0	Completed Facilities
1	Threshold (High priority facilities to be completed first)
2	Target (High Priority facilities to be completed by 2006)
3	Max (Next priority facilities to be completed as resources allow)
4	Other (Facilities to be scheduled 2007 – 2025)
5	'The Big 3' – 221-F, 221-H, & 221-S

The facilities database and RSM allows the user/organization to determine building groups for different case runs and scenarios, update facility schedules based on remaining funding and schedule for subsequent fiscal years, and future contract changes/commitments.

The considerations that drive near-term (through 2006) sequencing decisions differ from those affecting longer-term sequencing; therefore, different weighting factors are applied in the scoring for each Building Group. The database allows the user to define any number of "scoring schemes" with different parameter combinations and weighting. An appropriate scoring scheme is applied for each Building Group depending on the important considerations affecting that group.

Sequencing

An annual budget profile is input by the user for each fiscal year, and the model divides them into monthly budgets. The model analyzes all of the facilities on a monthly basis, using their ranking, availability date, ROM Cost, and duration to choose when to start each facility from the start through 2025. In cases where a facility is required to start, based on stakeholder or contractual commitments and duration, the facility is allowed to exceed the budget ceiling as necessary to complete it in the committed time frame. Once a decommissioning of a facility begins, the model continues it to completion.

Figure 2 shows an example graphic output from the Ranking and Sequencing Model. In this case, the model has performed the scoring and ranking of all facilities in the Max and Other Groups (approximately 1,000 facilities) and using an annual budget of $70M, has sequenced the facilities over the years 2007 to 2025. The color coding shows which SRS Site Areas are being worked in each month of this period.

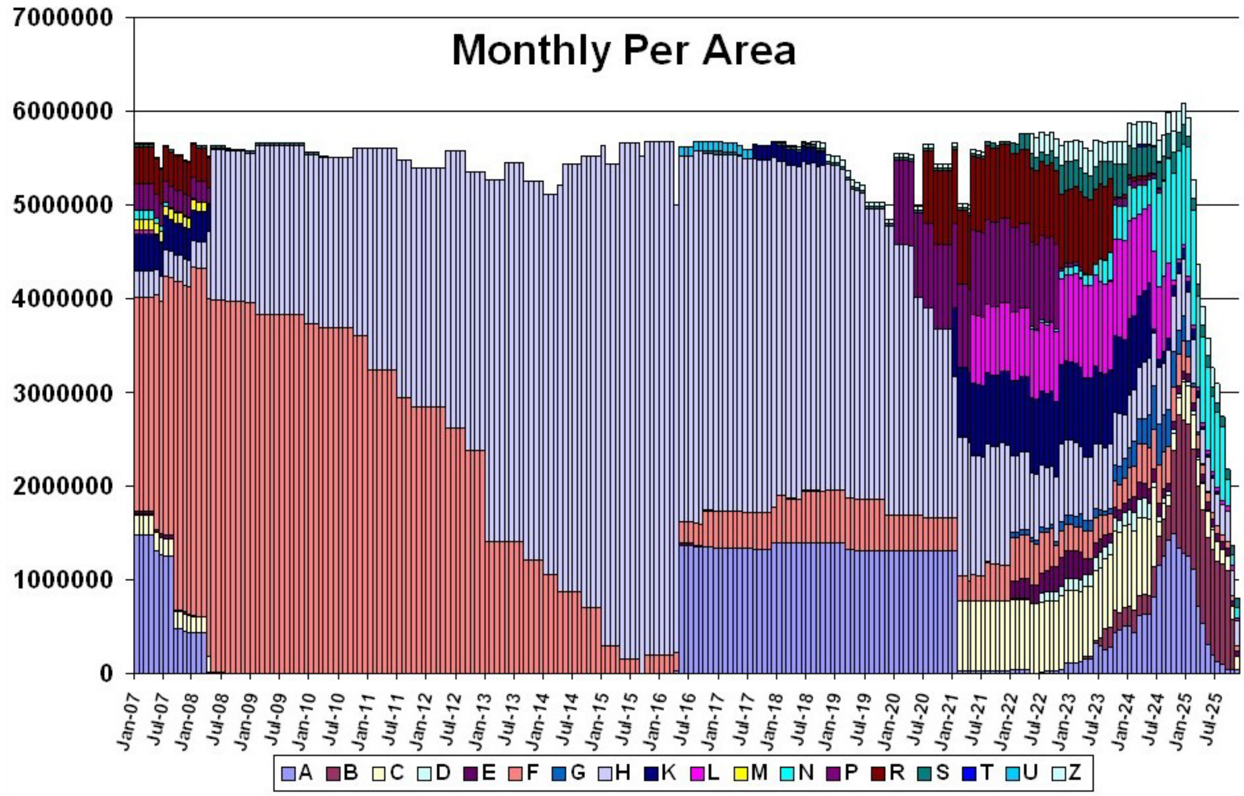

Fig. 2 Example output from ranking and sequencing model

The monthly expenditure for the sequence of facilities is exported to Primavera Project Planner (P3) to produce an optimized decommissioning schedule. Additional manual sequencing and schedule adjustments can be made, before a baseline schedule is approved, based on management guidance with respect to:

- Composite work efficiency. For example:
  - Economies of scale, such as performing similar work or work done by a single subcontractor concurrently
  - Achieving full closure of areas or sub-areas of the site (i.e., so that a small number of low-priority facilities are left in an otherwise closed site)
- Visual considerations:
  - Elimination of high profile facilities
  - Elimination of eyesores

The Ranking and Sequencing Model allows the user to easily perform analysis of cases with different sets of assumptions. Cases may include:

- Different weighting of main factors
- Differing budget/funding profiles
- Impacts of inclusion or elimination of facilities or groups
- Analyzing for remaining scope, cost, and schedule

REFERENCES

1 "Savannah River Site Environmental Management Integrated Deactivation and Decommissioning Plan" WSRC-RP-2003-00233 Revision 1, Westinghouse Savannah River Company, September 2003