APPENDIX A

Logistics Study

A1 Introduction

The major processes associated with the receipt of used fuel, its packaging and emplacement are summarised in this document with an initial assessment of the durations for these activities. There are a number of activities that will be carried out in parallel with these main activities but as these will not affect the throughput capability of the DGR they have not been listed at this stage. Examples of these would be operations associated with placing used fuel storage/shipping modules in the storage pool, supplying new empty UFCs or baskets into the packaging process and handling/exporting scrap used fuel basket components.

The aim of this assessment is to establish that the required throughput can be achieved and to ensure that there are no major constraints imposed by the proposed used fuel packaging plant (UFPP) and DGR layouts.

The initial assessments were carried out based on information given in the request for proposal [1]. However, additional information was subsequently provided and the implications of this are addressed in Section A11.

A2 Facility Throughput for Used Fuel

The specified throughput for the DGR was set at 120,000 used fuel bundles per year with a total requirement of 3,600,000 fuel bundles over the 30 year operating period of the facility. It has been assumed that the facility will operate 230 days per year.

The following Table summarises the key data used in the assessment.

	Bundles per Unit	Total Throughput	Annual Throughput	Daily Throughput
Total Used Fuel Bundles	1	3,600,000	120,000	522
Fuel Received in Sealed Baskets (8.1%)	60 (54)	4,935	165	0.72
Number of Basket Casks	180	1645	55	0.24
Fuel Received in Modules (91.9%)	96	34,453	1148	5
Number of IFTCs for Modules	192	17,227	574	2.50
Number of UFCs	324	11,111	371	1.61

A3 Cask Receipts

Used fuel bundles will be received in two cask types, Basket Casks and Irradiated Fuel Transport Casks (IFTCs) for modules. The total cask receipts will be less than 3 per day (2.74 averaged over the 30 years) and the operations will be similar for both cask types.

From	To	Duration (Minutes)	Comment
Road Transport	Cask Buffer Store	20	Using Crane
Cask Buffer Store	Cask Transporter	15	Using Crane
Remove Impact Limiter		10	Using Crane
Impact Limiter moved	Parking Position	10	Using Crane
Cask Transporter	Vent/Unbolt Cell	10	Using Transporter
Vent and Remove Bolts		50	On Transporter
Vent/Unbolt Cell	Receipt Cell	10	Using Transporter
Remove Lid and Contents (2 Modules or 3 Used Fuel Baskets)		60	Using In Cell Crane
Load Modules (2 empty modules into IFTC only)		60	Using In Cell Crane
Receipt Cell	Vent/Bolt Cell	10	Using Transporter
Bolt Lid and Test		50	On Transporter
Vent/Bolt Cell	Cask Transporter	10	Using Transporter
Cask Transporter	Cask Buffer Store	15	Using Crane
Cask Buffer Store	Road Transport	20	Using Crane
Total		350	5hr 50 mins

The total utilisation for the different handling features will be:

Module/Basket Transport Cask Crane	60 minutes per Cask
Cask Transporter	260 Minutes per Cask
In Cell Crane	130 minutes per Cask

It may be necessary to decontaminate casks on occasions and this will increase the utilisation of the Cask Transporter by some 240 minutes.

Utilising only one Process Line will result in a total utilisation of the Transporter of (3 x 260 + 240 for decontamination) 1020 minutes or 17 hours. It is assumed that a double shift system will be employed, therefore more than one process line will be required to meet the throughput. Assuming an operational efficiency of 85%, one line would be able to cater for two Casks being processed with one requiring decontamination [(2 x 260 + 240)/0.85 = 895 minutes or 15 hours].

It has been assumed that both modules can be removed from the Cask and placed on the Transporter, or in a park position in the receipt cells i.e. there is no need to await processing of the first module before the second can be unloaded.

A4 Module Processing

The required throughput for modules equates to an average of 5 per day. It has been assumed that up to three IFTCs per day will be unloaded, leading to six modules per day being processed. A number of these modules may be transferred to the buffer storage pool for short term storage; however, this operation will be carried out in parallel with other modules being processed.

From	To	Duration (Minutes)	Comment
Receipt Cell	Receipt Cell Cart Park	15	Unload Using In Cell Crane
Receipt Cell Cart Park	Fuel Module Handling Cell	15	Transfer Using Cart
Transfer Fuel to UFC Basket		180	Cart being Utilised
Transfer Basket to UFC or Storage Position	(Assuming basket is full part way through emptying module)	20	Using Fuel Handling Cell Crane
Fuel Module Handling Cell	Receipt Cell Cart Park	15	Return Empty Module on Cart
Remove and Decontaminate Module			Off Line Activity
Receipt Cell Module Store	Receipt Cell	15	Load Module into IFTC Using In Cell Crane
Total		260	3 hrs 20 mins

The total utilisation for the different handling features will be:

Used Fuel Handling Cell Crane	20 minutes per module
Transfer Cart	230 Minutes per module
In Cell Crane	30 minutes per module

The utilisation of the Transfer Cart will limit the number of modules capable of being processed in two shifts to 3.5 [(16 x0.85 x 60)/230 = 3.55]. This indicates that two process lines will be required to meet the module processing requirements.

Therefore, two Fuel Handling Cell fuel transfer machines will be required.

A5 Sealed Storage Basket Processing

To satisfy throughput requirements less than one Sealed Storage Basket (SSB) per day on average will be received at the UFPP. However, for the purposes of this assessment a throughput of one SSB per day has been assumed.

From	To	Duration (Minutes)	Comment
Receipt Cell	Receipt Cell SSB Rail Car Park	15	Unload Basket using Receipt Cell Crane
Receipt Cell SSB Rail Car Park	Cutting and Fuel Bundle Transfer Cell	10	Transfer using SSB Rail Car
Cut SSB and dispose of waste		150	SSB Rail Car in use
Transfer Fuel to UFC Basket		120	UFC Basket and SSB Rail Car in use
Cutting and Fuel Bundle Transfer Cell	Fuel Basket Handling Cell	10	Transfer using UFC Basket Rail Car
Transfer UFC Basket to UFC or Storage Position	(Assuming UFC Basket is full part way through emptying SSB)	20	Using Fuel Handling Cell Crane
Fuel Basket Handling Cell	Cutting and Fuel Bundle Transfer Cell	10	Transfer an empty UFC Basket using UFC Basket Rail Car
Remove and decontaminate SSB, dispose of waste	(Decontaminate off line)	30	Using Cutting and Fuel Bundle Transfer Cell Crane and SSB Rail Car
Cutting and Fuel Bundle Transfer Cell	Receipt Cell SSB Rail Car Park	10	Transfer Empty SSB Rail Car
Total		375	6 hr 15 mins

The total utilisation for the different handling features will be:

Receipt Cell Crane	15 minutes per SSB
SSB Rail Car	360 minutes per SSB
Cutting Cell Crane	30 minutes per SSB
Fuel Handling Cell Crane	20 minutes per SSB
UFC Basket Rail Car	160 minutes per SSB

From this analysis it is possible to process one SSB per day and it may be possible to carry out this operation within a single shift.

A6 UFC Filling, Sealing, Welding and Inspection

The UFPP will be provided with two independent UFC filling lines. It has been assumed that each line will process up to one UFC per day.

From	To	Duration (Minutes)	Comment
UFC Store Cart	Receipt Station	10	Transfer UFC using Cart
Load into Shielded Cart		15	Using Receipt Cell Crane
Receipt Station	Fuel Handling Cell	15	Using Shielded Cart
Open gate, raise UFC and remove steel inner lid		20	Using Fuel Handling Cell equipment/Cart
Load UFC with three UFC Baskets	(See Below*)	45	Using Fuel Handling Cell Crane/Cart
Replace steel lid, lower UFC and close gate		20	Using Fuel Handling Cell equipment/Cart
Fuel Handling Cell	Venting/Sealing Cell	10	Transfer full UFC on Shielded Cart
Raise UFC, vent and seal inner container, lower UFC		80	Using Shielded Cart
Venting/Sealing Cell	UFC Welding Cell	10	Transfer full UFC on Shielded Cart
Raise UFC, vacuum area, weld copper lid, lower UFC		180	Using Shielded Cart, welding equipment
UFC Welding Cell	UFC Inspection Cell	10	Transfer full UFC on Shielded Cart
Raise UFC, inspect weld, lower UFC	Radiography followed by Ultrasonic NDT	240	Using Shielded Cart
UFC Inspection Cell	UFC Receipt Cell	10	Transfer full UFC on Shielded Cart
Raise UFC into Receipt Cell		15	Using Receipt Cell Crane
UFC Receipt Cell	Receipt Station	10	Transfer empty Shielded Cart
Total		690	11 hr 30 mins

The total utilisation for the different handling features will be:

Receipt Cell Crane	15 minutes per UFC
Shielded Transfer Cart	680 minutes per UFC
Posting in Cell Crane	15 minutes per UFC
Welding Equipment	180 minutes per UFC

NDT Inspection equipment 240 minutes per UFC

The utilisation of the Shielded Cart extends to the bulk of the operations, although a number of the durations are determined by other activities. The Shielded Cart will be utilised for 680 minutes and with an operational efficiency of 85% will result in over 13.3 hours to process a UFC. A two shift system on each line will provide adequate capacity to process two UFCs per day, with the third shift available for such tasks as re-work of welds or additional NDT, if required.

* The foregoing times are based on filled baskets being stored in the Fuel Handling Cell until three baskets are available for loading in to a UFC. The baskets are then loaded into the UFC consecutively.

A7 UFC Monitoring and Decontamination

One UFC per day will be required to be processed through each of the two facilities.

From	To	Duration (Minutes)	Comment
Raise UFC into UFC Receipt Cell		15	Using In Cell Crane
Receipt Location	Monitoring Station	10	Using In Cell Crane
Swab and Monitor UFC		30	
Monitoring Station	Decontamination Booth	10	Using In Cell Crane
Spray UFC and dry		60	
Decontamination Booth	Monitoring Station	10	Using In Cell Crane
Swab and Monitor UFC		30	
UFC Receipt Cell (Monitoring Station)	Jacketing and Dispatch Cell	10	Using In Cell Crane
Open gate, lower UFC and close gate		15	Using In Cell Crane
Total		190	3 hr 10 mins

The total utilisation for the different handling features will be:
In Cell Crane 70 minutes per UFC
Spray Booth 60 minutes per UFC
Swab and Monitor Equipment 60 minutes per UFC

As only one UFC needs to be processed per day through each monitoring and decontamination line, ample capacity is available to satisfy the throughput requirements.

A8 UFC Jacketing

One UFC per day will be required to be processed through each of the two facilities.

From	To	Duration (Minutes)	Comment
Sealing Materials Compaction Plant	Dispatch Cell	10	Bentonite Blocks on Railcars
Offload Blocks and assemble in Support Frames		60	Using In Cell Crane and Support Frame
Withdraw Railcar and personnel		10	Support Frame in Use
UFC Receipt Cell, open gate, lower UFC and close gate	Jacketing and Dispatch Cell	15	Using In Cell Crane and Support Frame
Raise Support Frames to vertical and encase UFC		30	Use Support Frame
Lower to the horizontal and remove top support		30	Using Support Frame
UFC Cask Storage Area	Dispatch Cell Location	15	Transfer empty UFC Cask on Railcar
Open gate, transfer UFC and close gate		15	On roller bed into Cask
Dispatch Cell Location	Waste Shaft	15	Transfer full UFC Cask on Railcar
Total		200	3 hr 20 mins

The total utilisation for the different handling features will be:
In Cell Crane 75 minutes per UFC
Support Frame 175 minutes per UFC

The UFC jacketing support frame will be utilised for the majority of the operations. However, with an estimated overall duration of some 4 hours, allowing for an operational efficiency of 85%, ample capacity is available to meet throughput requirements.

A9 UFC Cask Movements

Although on average only 1.61 UFCs need to be emplaced per day, for the purpose of the following assessment two UFCs per day have been assumed as the maximum DGR throughput. It is proposed that the Cask used to transfer UFCs from the UFPP to the underground emplacement rooms will have a capacity of one UFC. Movements of UFCs and associated items are listed below, together with an estimate of their durations:

A9.1 UFC Cask Movements (Two cask movements per day required)

From	To	Duration (minutes)	Comment
UFPP Storage	Waste Shaft	10	Full
Waste Shaft	Underground Storage	15	Full
Underground Storage	Emplacement Room	20	Full
Unload Cask		60	Emptying
Emplacement Room	Underground Storage	20	Empty
Underground Storage	Waste Shaft	15	Empty
Waste Shaft	UFPP Storage	10	Empty
Total		**150**	
UFPP Storage	UFPP	10	Empty
Load Cask		60	Filling
UFPP	UFPP Storage	10	Full
Total		**80**	

A9.2 Buffer Plug Cask Movements (One cask movement per day required)

The following assessment assumes that the Buffer Plug Cask will be loaded at the Sealing Materials Compaction Plant (SMCP), located at the DGR surface facilities.

From	To	Duration (minutes)	Comment
Load Cask		30	Filling
SMCP	Waste Shaft	10	Full
Waste Shaft	Underground Storage	15	Full
Underground Storage	Emplacement Room	20	Full
Empty Cask		30	Emptying
Emplacement Room	Underground Storage	20	Empty
Underground Storage	Waste Shaft	15	Empty
Waste Shaft	SMCP	10	Empty
Total		150	

A9.3 Buffer and Dense Backfill Blocks (Eight rail car movements per day required)

Total volume of sealing materials required for the emplacement of two UFCs will be approximately 94 m^3 (3.2m x 5.73m x 5.13m). It has been assumed that sealing material pre-compacted blocks will be transported underground using flatbed railcars, each with a capacity of approximately 12m^3 (2m by 2m by 5m with a 60% packing fraction). This assumption will result in the requirement for 8 railcar movements between surface and underground to satisfy the emplacement of two UFCs.

Railcars may be assembled underground and transferred to the emplacement room as a train. However, each railcar will still have to be moved into the emplacement room individually. Individual movements for all operations have therefore been assumed.

From	To	Duration (minutes)	Comment
Load Rail Car		30	Filling
SMCP	Waste Shaft	10	Full
Waste Shaft	Underground Storage	15	Full
Underground Storage	Emplacement Room	20	Full
Empty Rail Car		30	Emptying
Emplacement Room	Underground Storage	20	Empty
Underground Storage	Waste Shaft	15	Empty
Waste Shaft	SMCP	10	Empty
Total		150	

A9.4 Light Backfill Hopper (One hopper/railcar movement per day required)

Approximately 12.5 m^3 of light backfill will be required per day. It has been assumed that this will be mixed (crushed granite and bentonite) at an appropriate surface facility and transported underground in a railcar mounted hopper. It has also been assumed that the hopper will accommodate the required 12.5 m^3 of material.

From	To	Duration (minutes)	Comment
Storage Area	Sealing Materials Plant	10	Empty
Load Hopper		30	Filling
Sealing Materials Plant	Waste Shaft	10	Full
Waste Shaft	Underground Storage	15	Full
Underground Storage	Emplacement Room	20	Full
Empty		30	Emptying
Emplacement Room	Underground Storage	20	Empty
Underground Storage	Waste Shaft	15	Empty
Waste Shaft	Storage Area	10	Empty
Total		160	

A9.5 **Ventilation Ducting, Rails and Services** (Four movement per day required)

From	To	Duration (minutes)	Comment
Parking	Emplacement Room	10	Empty
Load		30	Loading
Emplacement Room	Spare Emplacement Room	15	Loaded
Unload		30	Emptying
Spare Emplacement Room	Parking	10	Empty
Total		95	

A10 Summary of Movements in Different Areas

A10.1 Waste Shaft Movements

Item	No of Movements	Duration (minutes)	Comment
UFC Cask	4	88	Two full, two empty
Buffer Plug Cask	2	44	One full, one empty
Pre-compacted Blocks	16	352	Eight full, eight empty
Light Backfill Hopper	2	44	One full, one empty
Total	24	528	

Assuming an Waste Shaft operating efficiency of 85%, the 528 minutes given above will equate to 10.4 working hours. The travel time for a single waste shaft journey of 22 minutes is similar to that used for previous DGR studies and includes nominal waiting time.

A10.2 Perimeter Road Operations

Item	No of Movements	Duration (minutes)	Comment
UFC Cask	4	80	2 full, 2 empty
Buffer Plug Cask	2	40	1 full, 1 empty
Pre-compacted Blocks	16	320	8 full, 8 empty – may be moved in trains
Light Backfill Hopper	2	40	1 full, 1 empty
Redundant Equipment	8	120	4 full, 4 empty
Personnel	6	120	Assume 3 shifts, using perimeter road.
Total	38	720	

Not all movements will be between the waste shaft and emplacement rooms. Therefore, it may be possible to undertake a number of the movements simultaneously. The individual movements would therefore need to be defined in greater detail to ensure traffic conflicts do not occur.

A10.3 Emplacement Room Movements

A four day cycle has been assumed for filling each emplacement room, to emplace two UFCs (one day), the required sealing materials (two days) and one day free to complete operations elsewhere. Four emplacement rooms will be worked on in parallel using the emplacement sequence shown in Figure A1.

Item	No of Movements	Duration (minutes)	Comment
Unload UFC Cask	2	120	60 minutes each
Transfer UFC to Emplacement Location	2	120	60 minutes each
Unload Buffer Plug Cask	2	60	30 minutes for each pair
Transfer Buffer Plugs to Emplacement Location	2	60	30 minutes per UFC
Unload Light Backfill Hopper	1	30	
Strip Out Redundant Equipment		180	Allow 3 hours
Load Redundant Equipment	4	120	30 minutes per railcar
Sub-total		**690**	11.5 hours
Place Pre-compacted Blocks	120 blocks (2 teams)	**1200**	See Below
Total	16 (8 round trips)	**1890**	31.5 hrs

A detailed analysis of block placement was undertaken to establish the likely number of blocks and their configuration to determine realistic placement durations.

Based on Figure 1 in the main report, it is envisaged that the cross section of the emplacement room will be made up using 7 Dense Backfill Blocks and 9 Buffer Material Blocks. It is assumed that the blocks will all be approximately 0.9m long requiring 6 layers to accommodate each pitch along the emplacement room. This equates to 42 dense backfill Blocks and 54 Buffer Material Blocks, 96 in all. The lower areas under each UFC will be filled with a total of 12 Dense Backfill Blocks and 12 Buffer Material Blocks giving a grand total of 120 blocks to be placed.

Assuming 20 minutes to offload and position each block the overall duration would be 2400 minutes (40 hours). Based on 85% operating efficiency this would require an operational period of 47.0 hours.

Once the blocks are offloaded it will be possible to utilise two sets of lifting equipment to place blocks in parallel. This would result in an overall duration of 1200 minutes (20 hours) and taking into account 85% efficiency would result in 23.5 hours of operational time. This could be achieved using four teams on a two shift system with the two teams on each shift working in different emplacement rooms. Such a scenario would provide 28 hours of effort, assuming 7 hours per shift allowing for underground operators travel time. This would allow a time of just over 25 minutes to place each block, rather than the 20 minutes originally assumed.

UFC emplacement operations require 11.5 hours per day. Taking into account an efficiency of 85% this results in 13.5 hours per day being required; a time that can be achieved during two shifts.

From the above It is proposed that there will be a total of four teams of sealing materials placement workers and two teams of UFC emplacement workers. The emplacement sequence shown in Figure A1 outlines how the work would be organised, based on working a double shift system.

This would involve two sealing materials teams installing blocks in Rooms 1 and 2 on the first shift of Day 1, followed by a further two sealing materials teams carrying on with the installation of blocks in both Rooms 1 and 2 in the second shift. On Day 2 the same pattern would be used resulting in the completion of block installation in both Rooms 1 and 2 by the end of Day 2.

On Days 3 and 4 the sealing materials teams would complete installation of blocks in Rooms 3 and 4. In parallel the first emplacement team would install the first UFC in Room 1 on Day 3, shift 1 and the second UFC would be installed by the second emplacement team on shift 2 of Day 3. On Day 4, shift 1 the first emplacement team would install the first UFC on shift 1 and the second emplacement team would install the second UFC on the second shift of Day 4.

On Days 5 and 6 the teams would install blocks in Rooms 1 and 2 and UFCs in Rooms 3 and 4. The teams would continue to alternate between rooms in this manner until the rooms were filled. The same procedure would then be used for the next four rooms.

A11 Amended Delivery Rates

The information supplied in [2] gives details of the expected rate of deliveries for sealed baskets and modules.

The implications of this are that up to approximately 30,000 fuel bundles may arrive in sealed baskets for the years 2040 to 2046, the remaining 90,000 arriving in modules. During this period approximately 500 sealed storage baskets would have to be handled per year, equating to 2.17 per day. This would result in two basket casks per day being received and two (1.8) IFTCs.

From Section A3 it can be seen that there is sufficient capacity to handle four casks per day working on a two shift system, two of these would be on the basket line and two on one of the module lines. Occasionally a third shift may be required to receive and process a basket flask to maintain throughput. From Section A5 it can be seen that two sealed baskets can be processed in 12.5 hours. Assuming an efficiency of 0.85, this results in a 15.5 hours duration that can be accommodated by working a double shift system. A third shift may be required occasionally to accommodate the fact that just over two modules need to be processed per day on average. The module throughput is less than shown in Section A4.

Section A4 considers that six modules may need to be handled each day and the revised requirement from the above equates too less than this figure.

It is concluded that accommodating these revised figures, the fuel bundle delivery rates shown in [2] can be achieved by working a double shift, rather than a single shift in the basket handling line.

A12 Benchmarking

All durations assumed in this logistics study have been determined by assessing the tasks involved and allocating a time for each based either on the speed of the equipment envisaged, or on operational experience from previous projects where similar activities are involved. It is not possible to give definitive times for all operations as the level of detail is not available to carry out a full operational research study at this time. However, the durations arrived at for a number of the major activities have been compared with those determined for previous projects and have been found to be consistent.

Cask receipt, unloading and despatch times have been used to establish the validity of the derived DGR throughput rates compared with other facilities where information is available.

Typical turnround times for casks at UK nuclear facilities such as BNFL, Sellafield and UKAEA, Dounreay tend to be in the order of one to three days. These durations are based on the time for loading radioactive materials into casks rather than removing the contents from a previously checked and approved source, as is the case for the DGR. Quality Assurance and monitoring checks at the example facilities were also more involved than those envisaged for receipt of already certified casks. In addition, the nuclear utilities specified do not have a major driver to decrease the turnround times quoted, as it is normally other operations within the processes that influence the overall operational times.

Experience at Fort St Brain indicates that a turnround time of two days to load and unload a cask is typical. This involves 1.5 days to load and 0.5 days (4 hours) to unload.

For the Idaho Spent Fuel (ISF) Project in the USA, the design has assumed a cask turnround time of approximately 4 hours, this involves removing a single canister from the cask and replacing the cask lid.

At Hanford, also in the USA, within their canister store building, a turnround time of 8 hours has been achieved to receive, dock, unload, transfer the canister from a cask and place it in a storage tube.

One of the most appropriate benchmark in the UK would be the Nirex Deep Waste Repository for ILW, which is still at a design stage but where substantial work has been undertaken. From published information it is apparent that the repository will receive approximately 2,500 casks per year, where it is intended to process through either a single or double line facility. This number of casks equates to approximately 50 casks per week being processed as opposed to the 14 that are necessary for the DGR.

A13 Summary

This logistics study demonstrates that the required throughput can be achieved through all the process areas. This conclusion has been based on a requirement to process two UFCs per day, whereas the actual requirement is 1.61 UFCs per day on average. The study also demonstrates that the peak throughput for sealed storage baskets can be achieved between the years 2040 and 2047.

The study indicates that the most critical operations, from a throughput perspective, are those associated with installing pre-compacted sealing material blocks within the emplacement rooms. However, based on the assumptions made in the study the proposed method of UFC emplacement is viable. To ensure that satisfactory phasing of UFC emplacement and sealing materials is possible, emplacement of UFCs needs to be considered in parallel with sealing material block placement.

A14 References

[1] 2001. Technical Specification for Updating the Conceptual Design and Cost Estimate for a DGR for Used Nuclear Fuel. Ontario Power Generation, Nuclear Waste Management Division, Document No 06819-UFM-03789-0001-R00, Rev 0. Toronto, Ontario.

[2] Garamszeghy, M. 17 April 2002. Updated Shipping logistics and Fuel Age. OPG internal e-mail to T Kempe, R Heystee & J Villagran. Ontario Power Generation, Toronto, Ontario.

	Day 1			Day 2			Day 3			Day 4			Day 5		
	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3
ROOM 1	**A1**	**B1**		**A1**	**A2**		**E1**	**E2**					**A1**	**B1**	
ROOM 2	**A2**	**B2**		**A2**	**B2**					**E1**	**E2**		**A2**	**B2**	
ROOM 3							**A1**	**B1**		**A1**	**A1**		**E1**	**E2**	
ROOM 4							**A2**	**B2**		**A2**	**A2**				

	Day 6			Day 7			Day 8			Day 9			Day 10		
	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2		S1	S2	S3
ROOM 1	**A1**	**B1**		**E1**	**E2**					**A1**	**B1**		**A1**	**B1**	
ROOM 2	**A2**	**B2**					**E1**	**E2**		**A2**	**B2**		**A2**	**B2**	
ROOM 3				**A1**	**B1**		**A1**	**B1**		**E1**	**E2**				
ROOM 4	**E1**	**E2**		**A2**	**B2**		**A2**	**B2**					**E1**	**E2**	

S1 First Shift
S2 Second Shift
S3 Third Shift (Not Used)

A1	First Shift, First Backfill Team	B1	Second Shift, Third Backfill Team	E1	First Shift, First Emplacement Team
A2	First Shift, Second Backfill Team	B2	Second Shift, Fourth Backfill Team	E2	Second Shift, Second Emplacement Team

FIGURE A1 - EMPLACEMENT ROOM SEQUENCE