

Work based group project

ACDA5022.

Jacob Smith

Contents

Contents.....	2
1. Introduction	3
2. Group 2 plan	6
3. Student 1 approach.....	8
4. Combining work	14
5. Presentation.....	14
6. Reflection	15
7. References	16
8. Annex	17

1. Introduction

This document is intended as a summary of actions, decisions and interaction undertaken by an individual taking part in a group-based project. This group project forms part of the academic section of the Ordnance, Munitions and Explosives (OME) degree apprenticeship at the University of Wales Trinity Saint David (UWTSD) at the Swansea campus. This project forms a core part of the year 4 academic study, used to prepare the students for their final individual work-based project.

The student's involved had their class split into two groups, Group 1 contained all the students from one employer and group 2 contained a combination of other employer groups. This document will be covering group 2's project with a student of DE&S being the primary focus within this document.

The two groups were tasked to complete the same project, the aim of their project was to update an already existing explosive based equipment used by the royal engineers into an explosive article that utilises an Insensitive Munition (IM) compliant explosive fill [1]. The equipment in question is a rapid cratering kit Mk2, it is a kit that contains 4 items: A shaped charge (with standoff legs), 2x bag charges, a detonator, and firing line as shown below in figure1.



Figure 1: Rapid cratering kit image [1]

The rapid cratering charge is a simple tool used by the Royal engineers to quickly produce a large crater in the ground. The kit can be used in two ways:

1. The first method utilises the shaped charge to start the crating process. The shaped charge is erected to the required stand off distance using the supplied legs. It is then detonated producing a hole in the ground for the bag charges to be placed into and then detonated as well. The two bag charges produce the larger crater after the shaped charge has punched a hole into the ground. This method is primarily used on hard ground such as concrete and frozen ground where digging with hand tools is not possible.
2. The second method does not utilise the shaped charge. The engineers would first dig a suitable size (width and depth) hole for the bag charges to be placed within. They are then detonated producing the desired crater. This method is used in soft ground that is capable of being excavated using hand tools, such as mud and sand.

The students were also presented with a brief history of the equipment's development and how the primary source for the explosive fill (RDX/TNT 40/60) used for the explosive articles come from overspill from artillery shell filling [1].

The students were also presented with a list of aims to help guide them down the route they are expected to take. The aims are as follows [1]:

- Compare the performance of the new formulation with existing formulations.
- Obtain safety data.
- Propose a design for the cratering kit.
- Recommend a production route.
- Describe the Manufacturing to Disposal Sequence MTDS. Propose packaging.
- Propose a series of trials to prove the device meets the MTDS requirements.

The students were also presented a list of requirements this munition must be able to operate within, as a list of required and desirable. The key requirements can be seen in table 1 below [1].

Requirement domain	Required	Desirable
Climatic	Desert / Hot climate	All climate capability
Transportation land	Tracked and wheels	All vehicle capability
Transportation Air	Fixed and rotary wing	All air transportation

Table 1: Requirements list

As part of the information pack provided to the students there was a suggested explosive fill to be considered as the replacement for the RDX/TNT fill. The students were provided with a basic safety data sheet on this explosive fill, showing some basic data on this new explosive, this can be seen below in figure 2. Although this explosive fill was provided to the groups as a possible replacement to RDX/TNT fill it was not mandated it must be used. The groups were encouraged to investigate all possible alternatives explosive compositions to be used within the new crating kits.

Taw-Ex 2022 Preliminary Hazard Data Sheet				
Taw-Ex 2022 is a novel castable explosive formed using an novel energetic molecule and an HTPE binder system. The system is cured using a tin based catalyst and an isocyanate based curing agent. The formulation once mixed is a grey fairly mobile fluid displaying some non-newtonian properties. On addition of the curing agent and catalyst a workable pot life is limited to around 2 hours. On curing the formulation forms a solid material of around 100 Shore A hardness. The material has been manufactured in batches of 25Kg size, scaling up successfully from 1kg. The material is sensitive to moisture and molecular sieves are recommended for processing to avoid the formation of cavities.				
Density	1.8 g/cm ³			
VoD	8800 ms ⁻¹			
Small Scale Test Data				
Figure of Insensitiveness (Rotor)	60		(RDX 80)	
Figure of Friction	2.2		(RDX=3)	
	Yorkstone	Hardwood	Softwood	
Friction sensitiveness (Wooden Mallet)	100	100	50	
ESD	Ignitions at 0.45J but not at 0.045J			
Temperature of ignition	220°C			
Train test	Ignites and supports train steadily			
Bickford fuze test	Ignites and burns			
EMTAP tube tests				
Internal Ignition	Type 2	2 to 9 test vehicle body fragments		
Fast Heating	Type 2	2 to 9 test vehicle body fragments		
Slow heating	Type 2	2 to 9 test vehicle body fragments		
Small Scale Fragment Impact	Type 2	Detachment of septum. Up to 20% explosive consumed		
Large scale IM testing				
Not yet performed.				

Figure 2: TAW-Ex explosive data sheet [1]

After the presentation detailing the task to be undertaken the students were then left to plan and figure out their way forward on their own. This document is based on group 2's project journey covering 1 of the students designated area of responsibility which shall be covered in detail, showing how the tasks were divided up, how the student came to the conclusions and recommendations for the allocated section, and also how the student interacted with the other students in group 2 along with any external communications with other personnel not directly related to the project.

2. Group 2 plan

For simplicity and to prevent potential GDPR issues the students in group 2 will be known as Student 1 to 4 for the remainder of this document, with student 1 being the primary focus area covered by this document.

After the briefing for the group project, group 2 proceeded to have discuss a rough plan for the initial stage of the project. Where a rough plan was set out on how the group would approach achieving the desired goals of the project. Although these agreements were all verbal to start with student 1 and 2 produced a rough plan document to allow all involved to better understand what work would be required as part of this document. Students 1 and 2 then presented this document to students 3 and 4 where some adjustments were made before all the students agreed this document provided a good guide and contained enough detail of what was required to achieve this project. The group then proceeded to divide up the tasks required to be completed into individual responsibilities using a colour coding method. This plan can be seen below in figure 3.

Requirements (From Dave's PowerPoint)

1. Compare the performance of the new formulation with existing formulations.
2. Obtain safety data.
3. Propose a design for the cratering kit.
4. Recommend a production route.
5. Describe the Manufacturing to Disposal Sequence MTDS. Propose packaging.
6. Propose a series of trials to prove the device meets the MTDS requirements.

Plan

1. Introduction and background
2. User requirements document (URD)
3. Overview of current composition (TNT/RDX)
4. Explosive qualification
 - a. Chemical testing (STANAG)
 - b. Hazard testing (EMTAP)
 - c. IM testing (small scale)
 - d. Artificial aging
5. Comparison between new and old compositions
6. Redesign (if performance is not adequate) or retain design depending on performance of new composition.
7. System qualification: assign groups for different testing.
 - a. Artificial aging
 - b. Vibration
 - c. Diurnal cycling
 - d. Thermal shocks
 - e. Environmental testing (e.g. water ingress, salt spray)
 - f. Electromagnetic charge (EMC) tests
 - g. IM (full suite)
8. Packaging redesign – Not needed if munition doesn't require redesign.
 - a. Vibration
 - b. Diurnal cycling
 - c. Environmental testing
 - d. Drop test.
 - e. Bonfire test
 - f. Spigot.
9. Manufacturing
 - a. RAM mixing
 - b. General process overview including hardware.
10. Disposal (approved method is open detonation)
 - a. Briefly mention other disposal methods (be careful of scope creep!!)
11. Summary, recap, and conclusion

Figure 3: Group 2 project plan

The colours represented within the plan were used to highlight the individual roles as described in the previous paragraph. Table 2 below contains the key for the colours contained in figure 3 and the reasoning as to why each student was given that section of the project to manage.

Student No.	Colour	Section	Reasoning
All students	Red	Introduction, URD, Redesign if required, closing section	These tasks were given to all 4 students due to the majority of the content being none technical and no single student having a better understanding over the others.
1	Blue	System qualification	This section was given to student 1 to cover due to their current work position involving qualification of a weapon system. Therefore their knowledge and skill would be better placed here than any other section
2	Purple	Manufacturing and Disposal	This section was given to student 2 due to their job being in an area of energetic material manufacturing and disposal, better utilising their experience for the project
3	Green	Explosive qualification and comparison	Student 3 was given the task of exploring the explosive material suggested to the group (TAW-Ex) and a potential alternative explosive fill. This was given to student 3 due to their job involving explosive material development and access to various types of explosive data sheet.
4	Yellow	Packaging	Student 4 was assigned the packaging section due to their experience of packaging qualification in regard to IM reduction.

Table 2: Project plan key and reasoning

It was felt this division of tasking better utilised the individual student's knowledge and experience, with the hope of this approach producing a better for the presentation.

The students in group 2 having agreed the plan of attack also agreed a key goal/desire for the project to better assist them in their tasks and also to hopefully reduce the workload. This self-imposed goal was to use where possible an explosive fill with a similar density to that of RDX/TNT. The reasoning for this was twofold, firstly the student's approach to the project was that of the mindset to save costs (although fictional) where possible to better reflect a real-world scenario. The second reasoning for this was that by using the same density of explosive the external casing for the shaped charge, the already existing packaging, and all related transportation equipment (racking, tiedown scheme etc) would not need to be changed and thus reduce additional costing for modifications to existing equipment. The only exception in the packaging was although the sizing might remain the same changes could be made that results in a better IM compliance, this was to be investigated by student 4 of the group.

Group 2 also agreed to conduct ad hoc virtual meetings when not on campus to discuss progress and ensure everyone knew what they were doing and to help answer any questions anyone might have. The group also established a Discord group chat to allow for quick and simple conversations or questions to be dealt with. Over the timeline of the project the group held six meetings, their details can be seen below in table 3.

	MEETING	DATE	PURPOSE
1	In person meeting	5 th Feb	Discussed areas of expertise within the group and created a list of tasks and responsibilities which was split between the group
2	In person meeting	6 th Feb	Added further detail to the list of tasks and responsibilities. Discussed basic ideas such as replacing the explosives/compositions within the RCK, but keeping a similar design
3	Design Review	11 th March	Group met with Dave Holley to discuss design ideas to date. Feedback received on good progress.
4	Conference call on Discord	21 st May	Discussions on the developments and progress of each team member's respective tasks/responsibilities. Feedback between team members to inform on next steps in personal tasks and to ensure coherence in overall design between the sections.
5	Group work sessions on campus	3-5 th June	Meeting to discuss final ideas/design from each team member's tasks and responsibilities. R&D on explosive compositions analysed and final composition chosen for design and to ensure suitability for manufacturing. Begin to create the presentation.
6	Group work sessions on campus	5-7 th June	Team members working both individually and together to finalise presentation.

Table 3: Group 2 project meetings

3. Student 1 approach

Student 1's responsibilities in this project is to develop a system qualification plan for this equipment, a system qualification plan to show the new version of the rapid cratering charge is safe and suitable for service. The reasoning behind student 1 being tasked with this responsibility stems from the fact the student's day job is to manage the system qualification for all the energetic components on a new weapon system currently under development for the Ministry Of Defence (MOD).

The system qualification approach is a way to demonstrate the whole system (The shaped charge and the bag charges are two separate systems to the overall system¹) is safe and suitable for use, by subjecting the system to a series of trials used to represent environmental conditions and stimulus it could be subjected to as part of its lifecycle.

¹ Unless specifically stated, when the word system is used within this document it is in reference to the whole system of one shaped charge and two bag charges.

All though student 1's day to day experience involved system qualifications of energetic materials they are not an expert in this area, and they rely on Subject Matter Experts (SME) that work within the Weapons Technical Services (WTS) group. WTS are an in-house advice centre for the MOD Weapon Operating Centre (WOC). WTS advise delivery and project teams² in specialist engineering and scientific areas such as vibrations, qualifications, energetic materials, and initiation devices to name a few of their specialist areas. Due to the specialist knowledge and close relationship student 1 has with the qualification expert in WTS, student 1 contact the individual asking for guidance and advice on the appropriate standards and documentation they should investigate to obtain the correct testing regime for the rapid cratering charge.

The response from the WTS expert contained a list of every appropriate DEF STAN, a DEF STAN is shorthand for Defence Standardization which develops and pursues Mod's standardization policy, nationally and internationally using civil and military partners to support interoperability and more effective acquisition [2]. The response from the WTS expert provided a valuable starting point for the student to develop the qualification plan, the key contents from this email can be seen below [3].

1. The process for assessing safety and suitability for service of munitions is set out in Allied Ordnance Publication (AOP) 15. This includes the environmental questionnaire in Annex A³ where the life cycle environments should be captured.
2. DEF STAN 00-035, Part 2, Chapter 2-01 sets out the process for developing a Sequential Environmental Trials (SET) programme.
3. DEF STAN 00-035, Part 3 sets out the fall-back tests that can be used in the SET, although tailored tests may be appropriate in some cases.
4. There is some information on the sorts of destructive and non-destructive testing that could be conducted in AOP-63. This document is aimed at surveillance, but the same sorts of evaluation are applicable to a SET.
5. Details of tests for energetic materials can be found in AOP-7, this is aimed at the Qualification of Energetic Materials, but many of these tests are used during the Breakdown, Test and Critical Analysis (BTCA) conducted at the end of a SET. The EMTAP Manual (Energetic Materials Testing and Assessment Policy Committee Manual of Tests) also has information on these tests.
6. Other documents that may be of interest:
 - a. AOP-46 - The Scientific Basis for the Whole Life Assessment of Munitions
 - b. AAS3P-01 - Allied Ammunition Safety and Suitability for Service Assessment Testing Publication - Guidance

Not all of the documents provided were directly appropriate for student 1 plan but did provide valuable information for some of the other students within group 2. For example, point 5 contains details on material qualification which benefited student 3 work. Student 1 made sure student 3 was aware of this document and supplied student 3 with this document to assist in their area of the project.

From the documents provided AOP 15 and DEF STAN 00-035, Part 2, Chapter 2-01 provided the most suitable information in allowing student 1 to develop a qualification plan for the updated rapid cratering kit. Although the exact energetic material to be used in the updated version was not

² Delivery and Project teams are responsible for specific bits of equipment development or management depending on the equipment's lifecycle.

³ Annex A here refers to Annex A in AOP 15 and not the Annex A within this document.

known to student 1 for a large proportion of the project (due to student 3 task to find a suitable explosive fill) it did not hamper student 1 ability to conduct their part of the test. It was also the same for the work of all the students in group 2, none of each other's work/input into the presentation solely relied on the output of another student. This was the driving factor in the way the workload was divided up between the students, but taking this approach a student could demonstrate their own ability in their section without worrying on negatively impacting on another or relying on another's work to contribute to their own. It is only at the end where everyone's work is pulled together into one big picture does the work impact the other students.

The other approach decided as a team during one of the groups meetings was that the presentation would be pitched as if the team was trying to convince managers/decision makers on the most appropriate way forward to update the rapid cratering charge, using this approach would allow the students to better word their section of the presentation providing a clear path and structure to the group's presentation.

Due to this approach, it impacted the structure and approach student 1 would have with laying out their presentation and for that reason student 1 started the structure of his presentation with a basic summary of what Sequential environment trials (SET) is as part of system qualification and also described why safe and suitable for service (S3) was the driving factor behind this approach. SET and S3 are intrinsically linked with S3 being the over arching goal of any system in use by the British armed forces and SET being one of the contributing factors to the assurance that this system is indeed safe and suitable for service through the completion of a series of trials for the system.

Student 1 then went on to show the appropriate standards that applies to this section as demonstrated above with the extract from the WTS advisor's email. This was followed by a summary of the requirements needed to be met by this updated system. The requirements form a key part of the SET journey as the rational behind the specific sequencing of the trials is to represent as closely as possible the real-world environment the system could encounter [4]. This sequential approach was used by student 1 to structure their presentation which can be seen below in Annex A.

Student 1 then went on to show how the shaped charge and bag charges would be evaluated along the SET programme, utilising the data within AOP-15 and their knowledge of weapon system evaluation. Student 1 recommended the evaluation process would take the form of penetration tests for the shaped charge against Rolled Homogonous Armour (RHA) and open detonation for the bag charges. These tests would be recorded using testing equipment such as blast gauges, highspeed video (HSV) and real time x-ray Imaging. The reason behind the use of penetration against RHA and not ground penetration is due to the repeatability of this test, by testing against RHA a known target with know properties (hardness etc) and by stacking multiple plates it can be easily repeated. Showing that the shaped charge is either performing as expected with the same results as the controlled/baseline test (for example, the shaped charge penetrates 10 plates) or if the shaped charge is under performing (only penetrates 8 plates). This penetration test combined with the blast gauges, HSV and X-ray imaging can all be compared with the control testing to measure performance as the shaped charge progressing through the SET programme. The bag charges are simpler in nature and as such require just a simple open detonation trial whereas with the shaped charge the blast gauge HSV and X-ray imaging results can be compared with that of the control test. Using this approach student 1 demonstrated that there is a clear pathway for the system to be evaluated as part of the SET programme providing assurance and evidence the system can meet the S3 requirement.

For the Set to be successful the testing must be carried out against suitable environmental conditions the system could experience, these range from transportation vibration spectrum to temperature cycling and to long storage cycles to name a few. The specific levels that would be needed to be used for the SET is not something available to student 1, so the student presented a brief slide on how the appropriate levels could be obtained to provide more assurance that the SET was suitable for the system. Although AOP-15 and Def Stan 00-035 part 1 does contain some levels, these levels are pessimistic at best and wouldn't not accurately represent what the system could experience. Suggesting the use of Environmental Data Gatherers (EDG) to obtain the accurate data was the most appropriate route suggested that the programme could take if it was to proceed into a real-world programme.

Following on from the environmental conditions testing levels there would need to be a decision made on the duration of these trials, specifically around the transportation vibration duration. Fortunately for student 1 DEF STAN 00-035 Part 2, chapter 2-01 contains a table containing a generic use profile for various forms of explosive articles. This table was used to present a suggested duration the system could experience and this influencing the duration of the various vibration testing to be conducted. This table could be adjusted if the contracting element of this programme (if it proceeded to a real-world project) to better meet the contractual requirements, for example the ship transportation requirement could be set to only 10 months, which in turn would mean the transportation vibration trial for ships would be reduced to meet this requirement and also the salt spray test could be reduced as well.

Generic Usage Profiles for Land Based Munitions							
Munition Type	Transportation Mode						Operational Mode on Combat Platform
	Land Vehicles (km)	Ship (months)	Air Transport				Land Vehicles (km)
			Transport Jet Aircraft (hours)	Transport Propeller Aircraft (hours)	Transport Helicopters (hours)	Tactical Helicopters (hours)	
Artillery	5,000	8	20	20	20	-	N/A
Mortar	10,000	8	100	100	20	-	5,000
Tank Ammunition	5,000	8	20	20	20	-	5,000
Self-Propelled Gun Ammunition	5,000	8	20	20	20	-	2,000
Land Vehicle Mounted Missile	10,000	8	100	100	20	-	5,000
Anti-Tank Mine	10,000	8	100	100	20	-	2,000
Cannon Ammunition	10,000	18	100	100	20	-	5,000
Man Portable Missile	10,000	8	100	100	50	5	5,000
Small Arms Ammunition	20,000	18	200	200	50	5	5,000
Hand / Rifle Grenade	20,000	18	200	200	50	5	5,000
Land Forces Pyrotechnics	5,000	8	100	100	50	5	2,000
Demolitions	20,000	18	500	200	50	5	10,000

Table 4: Generic use profile for land-based munitions [5]

After student 1 set the scene within his presentation they then showed a series of appropriate environmental trials in the order they should be conducted in, these trials are as follows [6].

1. Transportation vibration road.
2. Shock packaged.
3. Temperature cycling.
4. Handling drops unpackaged.
5. Transportation vibration continued.
6. Transportation air vibration.
7. Parachute drop/UNDEX.
8. Climatic testing.

This sequence best shows what the system would experience in its life with step 1 encompassing transportation from the manufacture to the storage facilities. Step 2 encompasses any sort of drops

the system could encounter as part of the storage and transportation process. Step 3 encompasses industrial storage. Step 4 like the previous drops but is in consideration of the system being unpackaged as if it was about to be used. Steps 5 and 6 encompass any form of transport other than that of on a road, this includes off road, air transportation (rotary and fixed wing). Step 7 is included to help show how clearance for air dropping for the system could be achieved as well as proving the system is safe onboard a maritime vessel if it is subjected to an underwater explosion (UNDEX). Step 8 encompasses all environmental conditions the system could experience from driving rain, salt fog, plus dust and sand. All of these test's sequences would combine into a diagram to better illustrate the route map for these tests.

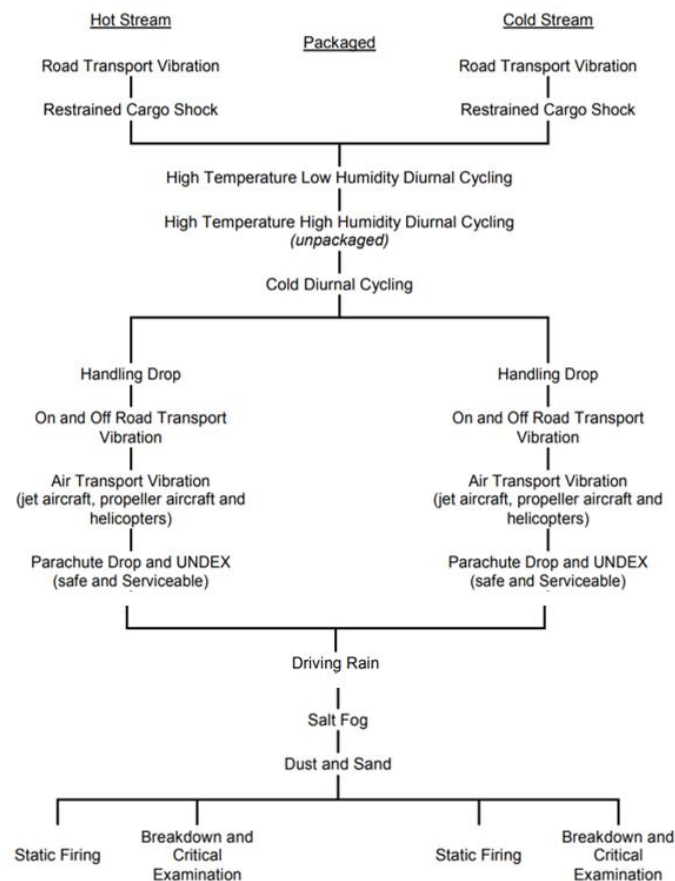


Figure 4: SET road map for Rapid cratering charge [6]

As can be seen in figure 4 there is the inclusion of hot and cold streams, these are included to demonstrate the system can survive the extremes of the temperature requirements, the exact temperature extremes were not provided as part of the project brief. That said these temperature extremes could for example be anywhere from -46 to +75 degrees Celsius.

Student 1 also produced 2 graphs showing how the shaped charge and bag charges would be tested after the respective trials. Table 5 below is a proposed test sequence to gain the greatest number of data points to prove S3.

	TU 1		TU 2		TU 3		TU 4		TU 5		TU 6		TU 7		TU 8		TU 9		TU 10		TU 11		TU 12		TU 13		TU 14		TU 15		TU 16		TU 17		TU 18		TU 19		TU 20		TU 21		TU 22		TU 23		
	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	A	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C		
Transportation vibration (road)	X	X																								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Shock			X	X																						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Diurnal cycling (high humidity)					X	X																				X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Diurnal cycling (Low humidity)							X	X																		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cold diurnal cycling							X	X																		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Handling drop									X	X																X	X	X						X	X	X	X	X	X	X	X	X	X	X	X	X	
On and Off road vibrations											X	X														X	X	X							X	X	X	X	X	X	X	X	X	X	X	X	
Air transportation (jet, propeller & rotary wing)													X	X												X	X	X												X	X	X	X	X	X	X	
Parachute drop / UNDEX																		X	X							X	X	X													X	X	X	X	X	X	
Driving rain																				X	X					X	X	X															X	X	X	X	
Salt fog																						X	X			X	X	X																	X	X	
Dust and Sand																								X	X	X	X	X																			

Table 5: SET sequence [6]

Student 1 recognised this approach is extremely costly and would require the use of 47 shaped charges and 47 bag charges to complete, incurring significant costs to the theoretical programme. Because of this student 1 produced a reduced SET sequence as shown in table 6.

	TU 1		TU 2		TU 3		TU 4		TU 5		TU 6		TU 7		TU 8		TU 9		TU 10		TU 11		TU 12		TU 13			
	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	A	
Transportation vibration (road)	X	X																								X	X	X
Shock			X	X																						X	X	X
Diurnal cycling (high humidity)					X	X																				X	X	X
Diurnal cycling (Low humidity)							X	X																		X	X	X
Cold diurnal cycling									X	X																X	X	X
Handling drop											X	X														X	X	X
On and Off-road vibrations													X	X												X	X	X
Air transportation (jet, propeller & rotary wing)															X	X										X	X	X
Parachute drop / UNDEX																	X	X								X	X	X
Driving rain																			X	X						X	X	X
Salt fog																					X	X				X	X	X
Dust and Sand																							X	X		X	X	X

Table 6: reduced SET sequence [6]

This approach would only require 13 shaped charges and 13 bag charges to complete, student 1 also explained that for Test Unit 13 (TU13) after each of the trials a series of Non-Destructive Testing (NDT) would be carried out, this way if issues started to develop as the testing progressed it could be spotted in time and a decision could be made on weather to proceed with the testing.

Student 1 also suggested an addition NDT sequential trial to be undertaken along side that shown in table 6. This approach was suggested to allow for better understanding on how the system is responding from a chemical and physical approach. As for example, NDT testing can chemically analyse the energetic materials response to Diurnal cycling for example.

Student 1 finished the slide pack with a brief conclusion stating these trails would help form a data package to support S3 compliance and how the results from the trials should be compared to that of the baseline system (A shape charge and bag charge evaluation without being subjected to any of the SET) allowing for an understanding of how the system would react over time. Student 1 also stated that throughout the life of the system it should also be subjected to a surveillance campaign where annually 1 shaped charge and 1 bag charge should be fired as per the evaluation step and also 1 shaped charge and 1 bag charge should be subjected to NDT to add to the data gathered in the

SET. By doing this you are combining the SET programme results to that of the real-world data adding to the S3 justification.

4. Combining work

Group 2's aim was to combine their work and produce the final presentation during the week leading up to their presentation to the project setters. Student 1 was the only student to arrive at the first meeting of that week with a completed section ready to incorporate into the group's presentation. Unfortunately, none of the other students in group 2 sections were available to review and extract data from, to use within the combined group sections (as detailed in figure 3 and table 2 above). It also became apparent student 4 was set on producing the other group sections by himself, despite not having his own sections completed. Student 1 tried to offer support and help to student 4 in producing this section, but the offers were not taken. Therefore student 1 could only practice and refine his section of the presentation much to their frustration.

Throughout the rest of the week leading up to the presentation student 1 attempted to support the others within the group but their progress on their sections was slow, which only added to the frustration experience by student 1. Despite the continuous offer of support to the other students in helping them to complete their sections, none of the other students accepted any help from student 1, further adding to the frustrations experience by this student.

Student 1 did request one of the other students to look through the slides they produced as a sanitary check but due to the other students still working on their slides this was not done and unfortunately resulted in a typo not being spotted in time as picked up by the presentation feedback [7].

It was only in the 45 minutes leading up to the start of the presentation, were all the slides combined into one presentation pack (Annex B). Unfortunately, during this time the formatting that student 1 did for the presentation was lost and the presentation section for student 1 appeared as a blank slide pack, giving the impression that the students slides were not as finalised as it would appear. With no time to rectify this issue student 1 just had to accept this issue and proceed into the presentation with the slide they produced not as finalised as originally set out.

5. Presentation

Despite student 1 frustration with the lead up to the presentation they proceeded to try and perform the best they could despite this. It was hopeful the confidence and delivery of their section would overcome and outweigh the disappointing look of their slides. From the feedback received afterwards, student 1 feels they somewhat achieved this goal [7].

Student 1 also answered as many of the appropriate questions directed at them with confidence and tried to further demonstrate they had completed their section of the work with as much knowledge and understand as was possible. Student 1 also attempted to assist the other students when they were presented with a question they were struggling to answer.

6. Reflection

Overall student 1 feels as if they had done the best as they could have given the circumstances surrounding the other students in group 2 actions. The initial start of the group project was a successful group effort with everybody involved, coming up with a suitable plan of attack and clearly defined responsibilities for the presentation. There were successful meetings following the initial plan setting both in person and virtually to discuss each other's progress (as shown in table 3 above). Unfortunately, this did not carry out all the way through the project for reasons described above.

Student 1 has since had time to reflect on the project and feels that despite achieving their goals to the best of their ability they should have taken a more of a leadership role within the group as they feel this was missing. With someone being in a leadership role it could have prevented the frustrations experience by student 1 and in turn provided an even better group presentation.

With that said student 1 feel that's despite the issues the groups aim was achieved, and the group did present a meaningful and knowledgeable proposal to the theoretical managers of the rapid cratering charge update programme. The final presentation was not as refined or polished as student 1 would have liked but they feel the correct information was presented and discussed during the final presentation.

This experience will also help student 1 in their development at their place of work and has allowed them to gain greater knowledge on the qualification programme for a weapon system whilst also helping them to better work as a team to achieve a goal despite the difficulties.

7. References

- [1] J. S. Dave Holly, *ACDA5022 BEng Group Project 2024*, Swansea: UWTSD, 2024.
- [2] UK Government, "Gov.uk," Ministry of Defence & Defence Equipment and Support, 30 01 2024.
[Online]. Available: <https://www.gov.uk/guidance/uk-defence-standardization>. [Accessed 05 07 2024].
- [3] WTS expert , *Email: 20240228 - Qualification DefStan*, Bristol, 2024.
- [4] Nato, "NATO - AOP-15 GUIDANCE ON THE ASSESSMENT OF THE SAFETY AND SUITABILITY FOR SERVICE OF NON-NUCLEAR MUNITIONS FOR NATO ARMED FORCES," Nato, 2009.
- [5] UK MOD, "MODUK DEF STAN 00-035: PART 2," MOD, 2017.
- [6] J. Smith, *Sequencial Environmental Trial presentation for Rapid cratering charge*, Swansea, 2024.
- [7] J. S. David Holly, *Group project presentation feedback*, Swansea, 2024.

8. Annex

Annex A

Student 1 presentation slides with original formatting

- ▶ Sequential Environmental Trials (SET) is a series of tests a munition must undergo to demonstrate it is Safe and Suitable for Service (S3)
- ▶ Safe and suitable for service
 - ▶ “The requirements needed to demonstrate that the inherent risks from Ordnance, Munitions and Explosives (OME) are either Broadly Acceptable or Tolerable and As Low as Reasonably Practicable (ALARP) for the MOD, third parties and the environment”.



Annex B

Group 2 project presentation as presented.

Rapid Cratering Capability

Design review and recommendations for a replacement capability to
the Mk II rapid cratering Kit