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The Disposal of Redundant Heavy Weapons

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02

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Introduction

This report outlines the principal conclusions of a NATO funded Advanced Research Workshop (ARW) and a subsequent Technical Working Group (TWG), the purpose of which was to investigate and recommend actions for the conversion or disposal of redundant former Soviet heavy weapons now located at dispersed sites particularly in Central Asia. Two conferences were held in Slovakia in October 2004 and January 2005.

In order to make a detailed analysis of the potential for a commercial conversion/dismantling project, a detailed understanding will be needed of the proposed process, supported by accurate data on a wide range of economic and other factors. While these requirements are only partly available, the expertise gathered at these two meetings has allowed a promising start to be made.

This paper therefore demonstrates a good level of confidence that a sound economic proposition can be made, in addition to the self-evident benefits of removing a source of environmental and political hazard.

Political Considerations

Background

In the 1990s many countries in Central Europe successfully disposed of large quantities of military equipment. However, they found the disposal of heavy weapons (tanks, artillery, etc) particularly expensive, with disposal costing between 3 to 5 times the value of recovered scrap metal. Specialist, now privatised, companies in Central Europe acquired significant experience in disposal techniques, which they are willing to share and explore further.

In the final years of the Cold War, the Soviet authorities moved vast quantities of military equipment out of European Russia and into peripheral areas of the USSR so as to avoid restrictions placed by arms control agreements. When the USSR disintegrated, these weapons stocks became the property of the newly independent states, and were at first considered an asset. However, over the past decade they have become a dangerous liability.

Kazakhstan alone has over 5,000 tanks and armoured vehicles and some 2,000 railway wagon loads of ammunition, Georgia has hundreds of heavy artillery pieces and several dozen heavy missiles (SS21). Ukraine has over a million tones of ammunition and explosives, some dating back to World War I. Several initiatives have targeted specific weapons or munitions which pose an urgent problem. For example, Ukraine's nuclear weapons; Moldova's toxic rocket fuel stocks. Small

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arms are already subject to major programmes of elimination. However the problems posed by the vast bulk of these cold war heavy weapons stocks have not been addressed at all. These weapons, long overlooked by the west, are now becoming a major problem for several reasons, viz:

1. The weapons' fuel and ammunition pose a serious environmental problem exacerbated by the lack of storage care, the extremes of climate to which they are exposed, and age.

2. The weapons are a serious obstacle to military reform and democratic control of armed forces. The former Soviet officers who have set up the armed forces of these new countries have been able to use the weapons stocks to justify expensive military organizational structures. The governments have only recently understood the crippling cost of maintaining this illusion of military power.

3. The bulk of these stocks are not well guarded and there are no effective export controls. The illegal export of these weapons is fuelling corruption and organized crime, both within the countries themselves and in countries through which they are exported illegally. The weapons from these stockpiles are beginning to appear on the black market in some parts of the world. There is serious concern that some of these weapons, explosives and toxic fuels will find their way into the hands of terrorists.

Scope of the Problem

No firm data are available. The following tables give the best estimates available at the time of the meeting to the working group.

Country	Main Battle Tanks	Armoured Personnel Carriers	Artillery
Kazakhstan	~5,500 across all types		
Uzbekistan	180	380	320
Turkmenistan	600*	1000	500
Kyrgyzstan	Negligible		
Tajikistan	Negligible		

* T72.

The table below provides data on main battle tanks.[1]

	Tank Type			
Country	**T72**	**T64**	**T62**	**T55/54**
Kazakhstan	600			
Uzbekistan	100	~100	179	80
Turkmenistan	570**			
Kyrgyzstan	210			
Tajikistan	40			
Ukraine	1,305	2,200		154
Georgia	31			58

Blanks in the table above indicate no data and imply a negligible or zero holding.
** According to the United Nations, Turkmenistan also exported 530 T72 to Russia between 1992 and 2000.

[1] Jane's Armour and Artillery 23rd Edition 2002/2003.

Developing a Strategy

The fundamental challenge is reaching agreement that something should be done. Any initiative requires a top down decision – ie political will, both nationally and internationally. States have other, more pressing priorities (for example, in Kyrgyzstan the environmental hazard of landfill and other sites is much greater than that posed by redundant large-calibre weaponry). Indeed, the possession of large quantities of heavy weapons is still seen by unreformed military structures as an asset more than a liability.

In addition, Central Asian states have neither the money nor the technology to dispose of heavy weapons. They would therefore have to seek international assistance for any such programme. This is complicated by the fact that donor and target states do not speak the same language, literally and metaphorically. Major power rivalry is seen as an opportunity for leverage – and several states look to Russia more than to the West. The issue of disposal is seen as having been raised by NATO – and is therefore its problem.

States do not expect international and regional organisations to afford practical help. Such organisations do offer an opportunity to identify problems through “awareness-raising”, though none are designed specifically for this purpose. The Commonwealth of Independent States (CIS), despite wide membership, is not geared for weapons disposal issues. The Shanghai Cooperation Organisation (SCO), whilst having a security dimension, is more focussed on economic cooperation. The requirement for unanimity virtually rules out the OSCE. Conferences and summits also offer an opportunity to operate on a bilateral basis – and for informal discussion.

NATO and NAMSA,[2] despite having some experience in the technicalities of disarmament, also have their limitations. The problem is too large for the NATO Trust Fund, which requires both an informal and a formal process. NATO is still seen in much of the former USSR as a military alliance – and yet the disposal issue is as much humanitarian and environmental as military. Sometimes, indeed, member states' interests are contradictory. The NATO International Staff are best placed to act as facilitators for countries, both donors and recipients, which wish to explore the possibilities in their early stages without commitment. Use of the NATO Trust Fund, when it is judged appropriate, would be the last stage in this process

At the national level governments need to be encouraged to see disposal as a priority problem – but how? Often an individual galvanises initiatives of this type, as Princess Diana did for landmines. Public relations and the media are vitally important in raising awareness of the issue (again, the Ottawa Convention on anti-personnel mines has been successful in this respect).

The process can be encapsulated in four stages:

1) Agree a national policy for both donor and target state(s)
2) Extrapolate into a regional policy to which all participants can sign up – building transparency on this and other issues too
3) Bring in technical people – to establish feasibility
4) Establish an economically manageable project

[2] The NATO Maintenance and Supply Agency.

Implementing a Strategy

Several practical steps are possible with a view to raising general international awareness of the problem from its current low profile. As already noted, media attention is vital in this regard. This needs to become an issue at a national level too, in both potential donor and potential recipient states. In order to promote transparency, a base line might be established by the creation of a data-base of holdings, on the lines of the UN arms transfer register. Priorities need to be thought through, perhaps by exchanges at international organisation level (UN, NATO, OSCE, etc) where international and bilateral initiatives can be facilitated.

It is unfortunately necessary to emphasise that in exploring the possibilities, both sides should defer to the ‘target' states' priorities, which do not focus solely on heavy military equipment – landfill, disposal sites, rocket fuel chemicals, ammunition dumps are all part of the same problem. Yet whilst demilitarisation can and should be linked to the processes of democratic and security sector reform it is important to draw in other government departments. Demilitarisation is a humanitarian, economic, environmental as well as security issue

Technical Considerations

Disposal Options

The first option considered was to **do nothing** and to leave the equipment to decay where it was. This was discounted for a number of reasons: the political embarrassment of having such decaying weapon systems on active military sites; the potential for long term environmental damage; the potential for danger from un-maintained or discarded ammunition in or around the vehicles; and the possibility of vehicles and their munitions finding their way into the hands of terrorist groups.

The second option of **dumping** either in a land fill site or at sea was also considered. This in effect is the same as the first option without the political problems but with all the environmental ones and a large cost.

The third option considered was to **remanufacture** the equipment into some useful form for either civil or military use. Suggested uses include: mine clearance vehicles using flail systems or ploughs; non-lethal riot control using water cannon and high expansion foam projection; specialized fire fighting equipments including inert gas blowers (using jet engines mounted on a tank chassis in place of the turret); and various other civil engineering uses such as pipe pulling, levelling, ploughing etc. Several designs have been realized by the participating companies.[1] However the numbers of such modified vehicles that have been produced and sold are quite small. For the volumes of vehicles under consideration this solution would only resolve the future of a few percent at best. The engineering knowledge and expertise needed to realize such solutions is considerable and may not be readily available in the states or the sites where the weapons are currently stored.

Should the units consist of the full balance of attack and support vehicles then much of this support equipment could be readily **adapted to civilian use** provided that the following conditions are met. These are that: the recovery and support vehicles themselves have not already drifted into “civilian” use; the equipment has not deteriorated too far in storage; spare parts are available and have not gone missing; maintenance details and materials can be obtained; and there is sufficient information on operation and maintenance.

A subsidiary third option of **selling** the vehicles once demilitarized to enthusiasts and other groups would at best dispose of only a very small number of the vehicles. It also raises the problem of the vehicles being re-militarized when in private hands. The distances involved and the resulting transport costs probably make this option not viable.

The fourth option is to **recycle the materials** from which the vehicles are manufactured. This would require the making safe of the equipments followed by the systematic dismantling, cutting up and sorting of the materials. The realizable material categories and volumes from a main battle tank such as a T62 are given in the table below. The main source of the aluminium alloy is from auxiliary equipments such as guards, tool boxes and stowage bins. The copper alloy comes from the bronze breech components. The lead is fitted in a matrix of plastic material as a radiation shield inside the crew compartment and is also present in the batteries.

Material	Estimated amount in tonnes per vehicle
Ferrous metal	34
Aluminium Alloy	0.5
Copper Alloys (Bronze etc)	0.12
Lead	0.4

Some intermediate uses may be found for some components, such as the gun barrels being used as primitive pilings or the turrets being employed as well caps, but again these uses are limited. The current prices of steel scrap may well make it more attractive to dispose of all the steel material by this route. There may also be markets for some of the ancillary equipment, such as communications devices, optics etc.

Hull steels are armour plate, a high ferrous alloy with chromium, manganese, cobalt, niobium and other alloying elements in significant quantities. These alloying elements cannot be separated in an electric arc furnace, and therefore to produce good quality usable steel for construction purposes for example, the recovered steel must be diluted with significant quantities of lower grade scrap.

While the dismantling and reduction is a (relatively) low-tech process, the detailed sorting and grading of scrap is not. For accurate identification of raw material it is possible that a metallurgical laboratory will be needed for analysis of individual components. For reasons of economics and technical availability such support for sorting is probably too accurate in this scenario. It may well be better to keep the cutting and reduction process quite “rough” with discrimination between ferrous and non-ferrous materials being carried out with the aid of small permanent magnets and then sorting into aluminium, copper or lead being based on material colour and source. Thus little attempt should be made to remove minor components of polymer, vitreous, electrical or electronic material as the potential economic benefit of accurate sorting does not outweigh the effort needed and these materials can be easily removed as slag in the scrap steel melting process or otherwise incorporated into the alloy without serious detriment to its properties.

The technical working group concluded that the markets for re-use and/or export were very limited. From the experience gained by industry in Hungary (see below) it was concluded that more than 95% of all vehicles would need to be disposed of by dismantling and the consequent recovery of their constituent raw materials.

	Summary of Proposed Solutions				
Recycling classes	Rescue Vehicle	Mine clearing	Fire fighting	Riot Control	Recrea-ational
Re-manufacture	Engine & fluid power	Dozer blade & flails	Foam and inert gas monitors	Non-lethal weapons	
Dismantle & re-use parts	Engine – power generator	Engine – water pumps	Lasers & optics		Gun sights & display units
Dismantle & recycle raw material	Steel to civil work	Light alloy to window frames	Rubber for road fill		
Dump	As sea defence	As reef for divers	In dam foundation	As boat mooring	In deep sea

Potential Hazards & Their Mitigation

The first problem facing any team tasked with dismantling these equipments is making the operational area safe. The whole area around the stored weapons must be searched for any potential hazardous material, such as tank ammunition, grenades, fuel cans etc.

Once the area has been secured each vehicle must be examined in detail to check its status about stored ammunition, explosive reactive armour (ERA)or other hazardous materials that might be present. Such an inspection phase must include an accurate record of the vehicle or equipment status so that future processes can be carried out with full knowledge of all potential hazards. New technology using data tags permanently fixed to the weapons systems could provide a robust method of recording status and potential hazards on initial inspection. Subsequently this could give much useful information to the decommissioning teams approaching the weapons some time later. Initial inspection information on an electronically readable tag that is permanently attached to a vehicle is a secure and stable information source.

A number of the armoured vehicles, especially the main battle tanks, were fitted with a unit to monitor the external atmosphere for chemical or biological attack. This unit, designated GO27, contains a Caesium isotope for ionisation purposes. This unit must be removed, stored securely and its disposal monitored carefully. There could be potential for terrorist use of such sources in a “dirty bomb”, if collected in sufficient quantity.

Once dismantling is underway other hazards may present themselves. These are likely to be due to interaction of the high temperature cutting process burning materials which release toxic vapours or particles. Attention will be required to safeguard the workforce from such problems and a proper risk assessment needs to be made. The cutting up of the vehicles using oxy-acetylene equipments poses a problem of potential explosions from remaining volatile gases inside internal storage tanks or structural voids, which stored or collected fuel or other hydrocarbon based liquids such as hydraulic oil.

Finally the batteries which powered the vehicle at start up contain significant amounts of acid which will need to be neutralized and will also require careful handling. There may also be a problem of creating electrical fires should this system not be decommissioned correctly.

Experience from Eastern Europe

The Hungarian experience of disposal of heavy weapon systems since the end of the communist regime has been extensive. The major contractor for weapons decommissioning, Currus RT[2], is a joint stock company with the majority shareholding held by the Hungarian government. They prepare equipments for military exercises and operations, participate in international missions, and carry out modernisation of military equipment. They also design, develop and manufacture new equipment, for example fire fighting vehicles, trailers and a universal mechanical weapons station. They carry out the technical preparation and any necessary repair prior to the long term storage of heavy weapon systems and the specialist technical training of crews and experts. The company was founded in 1952 and currently has a turnover of approximately €16m and employs 350 people.

The company has carried out the destruction of conventional armaments under the terms of the CFE treaty and is an officially registered reduction site under this treaty. Destruction has taken place profitably at both the company's own site and also at military sites where such equipment has been stored. The latter proved slightly more profitable due to the savings in transportation costs. All destruction and reduction to scrap has proved profitable with margins acceptable by Western European standards.

Since 1992 a total of 2,358 heavy weapon systems have been destroyed in Hungary. This total comprised 1050 main battle tanks, 948 armoured personnel carriers, 303 artillery pieces, 52 combat aircraft and 5 combat helicopters. Of the main battle tanks, armoured personnel carriers and artillery pieces taken out of service in the past twelve years (1992 to 2004) very few (approximately 1.4%) have been taken as museum exhibits or used as targets. Disposal costs were estimated at between €2,000 and €4,000 per vehicle depending on location.

The Czech situation is similar. The company VOP025[3] has carried out reduction to scrap profitably, albeit at modest margins. Estimates per vehicle of 120 man hours for preparation, cleaning and washing prior to cutting were given. Actual cutting took 40 man hours. The largest problem facing their decommissioning campaign was the adequate provision of cutting gas supplies. Estimates for gas consumption per vehicle varied from 200 to 1,400 litres of oxygen and 50 to 400 litres of acetylene. This campaign achieved a destruction rate of 50 vehicles per month at an approximate cost of €2,000 per vehicle. The Czech company markets a number of specialist non-military vehicles based on the T-72 chassis. No information was available about the success of their sales in this area.

The Slovakian experience, demonstrated during the conference, focused on the disposal of ammunition for these heavy vehicles. Two companies with similar capabilities were discussed and automated methods of dismantling ammunition shown.

An Economic Model

In order to establish an economic model for the dismantling of heavy weapons systems a systematic process needs to be determined by which the equipments are to be dismantled and their materials recycled. Once such a process has been established, then estimates of the costs can be constructed and hence an economic model constructed. A computer based model of the production engineering and economics of the dismantling process has been developed.[4]

Base Assumptions

The base assumptions for this model fall into two specific areas. The first concerns the safety and operability of any dismantling or remanufacturing activity. It is therefore assumed that:

- The area in which the vehicles are contained is secure from incursion by non-authorised personnel.
- All materials recovered can be stored after dismantling without fear of loss through pilferage.
- All explosive material and explosively unstable material has been removed from the secured area around the vehicles.
- All explosive material and explosively unstable material has been removed from the vehicles themselves.
- All components containing radioactive sources have been removed from the vehicles and are safely stored awaiting appropriate disposal.

The second base assumption is an economic one. It is assumed that:

- The costs of all the above safety measures to the project are excluded.
- The vehicles and their equipments are provided at no direct cost to the project.

Initial Model Assumptions

To build the model a proposed dismantling process has to be established. This requires some basic assumptions from which significant numerical data can be derived. Once these calculations have been made then estimates of other data are made and the model generates the consequential financial outcomes.

These base assumptions are as follows:

- There are 5000 vehicles to be dismantled
- They are all of a similar type
- They are located in large groups close to a railway
- They can be moved (towed) short distances
- They have been made safe by all ammunition and ERA has being removed
- It takes 160 man hours to dismantle a tank, made up of:
  120 man hours to dismantle and clean, and
  40 man hours of actual cutting [5]
- The productivity of local labour is half that of their equivalent Czech operatives
- The programme is to be completed in five years.

Assuming that the local workforce works for 40 weeks a year and manages a 50 hour week it will require 160 men for five years to dismantle 5000 vehicles. Every 4 weeks these 160 men dismantle 80 tanks. Assuming each tank generates 25 tonnes of scrap there will be enough scrap every 4 weeks to fill a train of 40 wagons at 50 tonnes per wagon.

Proposed Dismantling Process

It would be impossible to let loose a group of 160 workers on a field full of tanks without some coordinated plan of work. For the purposes of the model it is proposed that the 160 workers are split into 4 teams of 40 each working on five vehicles at any one time.

A pre-dismantling inspection has been assumed to have been carried out some time before and this has recorded the hazard status of each vehicle and possibly provided a data tag to each tank containing a hazard status report. Subsequently, skilled professionals have visited each vehicle and removed all ammunition, ERA if present and any instrumentation containing radioactive material.

The first task of such a team would be to empty the vehicle of flammable and other hazardous liquids (eg battery acid). The vehicle can then be dismantled with the help of mobile lifting equipment and then cut up. The resulting scrap can be segregated into ferrous, aluminium alloy, lead, copper and other. The majority of the scrap by weight will be ferrous and the disposal and transport of this scrap forms a major part of the resulting model. Other scrap materials have not been dealt with to the same level of detail.

Each team consists of 40 workers including a working supervisor and they are made up of 30 labourers and 10 burners. It would be extremely beneficial for team members to be cross trained to avoid skill shortage problems. For safety and efficiency reasons there should be slinging training (safe lifting) for everyone.

Payment for each team should be based on their output; that is the volume of ferrous scrap they produce. Payment to each squad should follow local custom best able to drive results. One suggestion is that the team leader is paid and divides up the earnings amongst the team while receiving a team leader bonus.

The two diagrams below show the cyclic operation of the dismantling process and how a row of five tanks could be progressively worked on. With teams of 40 there would be approximately 8 men per vehicle though it is envisaged that this would change in number and in balance of skills reflecting the needs of the various stages of the dismantling process.

Figure 1 – Cyclic Nature of Dismantling Operations

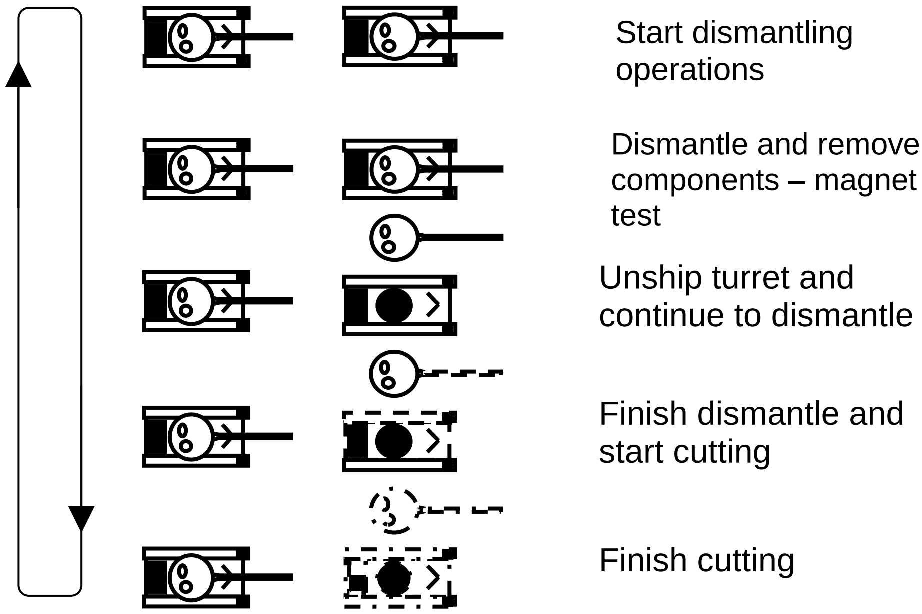
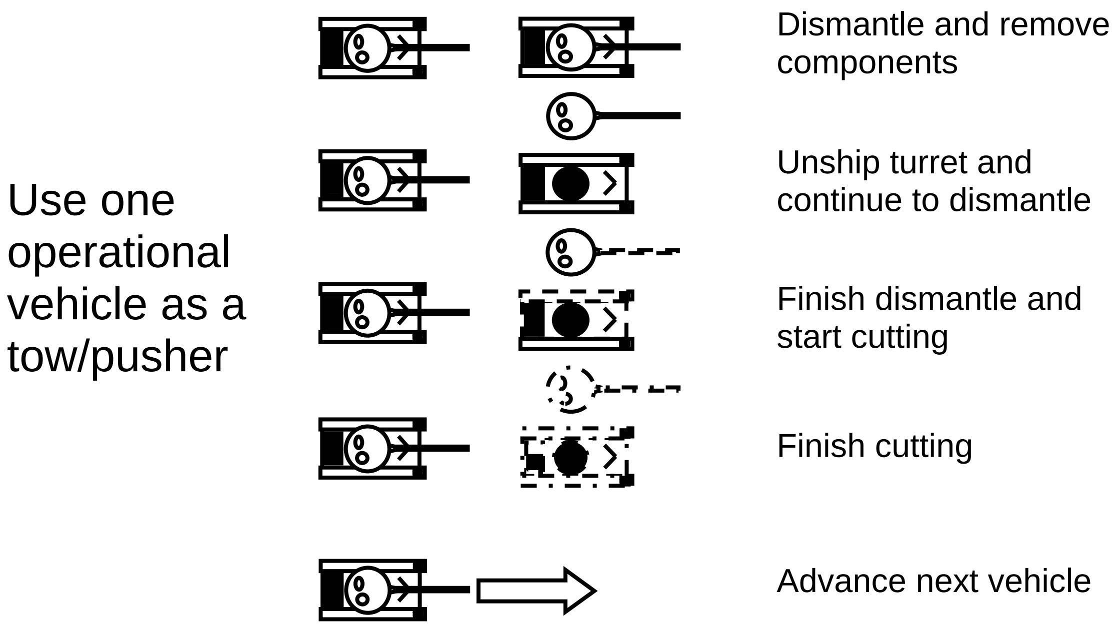
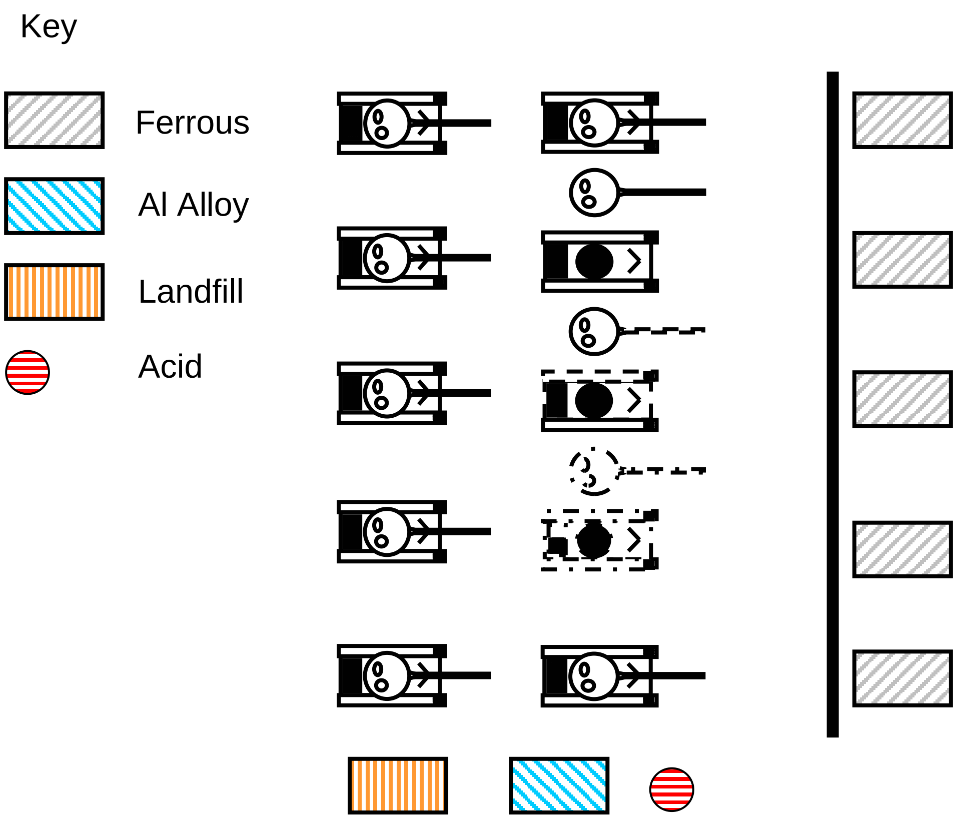


Figure 2 – Progression in the Dismantling Operations



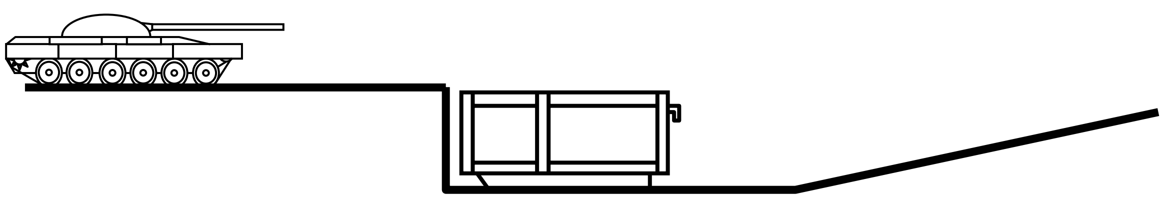
The diagram below shows the relative storage points for recovered scrap materials and other wastes. It should be noted that the process will generate a proportion of material that will need careful disposal and material that will need to be buried in a landfill site.

Figure 3 – Disposition of Material Reclamation Points



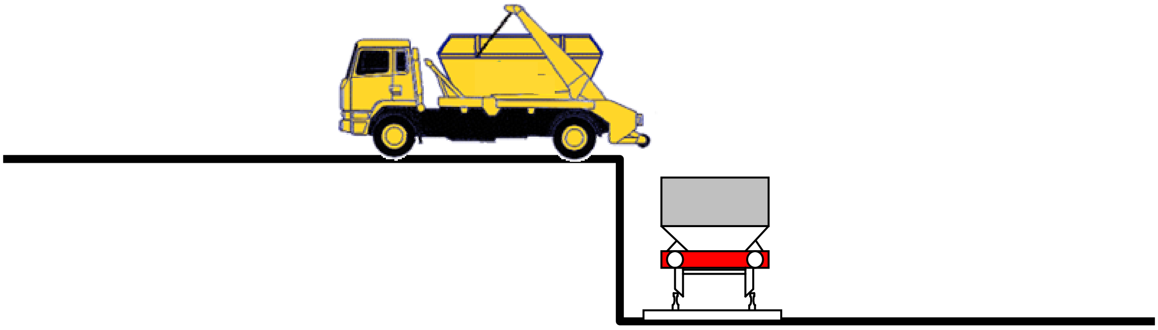
The diagram below shows potential layouts of the dismantling area which ease the dumping of ferrous scrap into lorry loadable skips. Alternate arrangements requiring no height access may be made but will be at a labour utilisation penalty. As the skips are filled dumping of scrap on the flat will carry an increasing need for labour when the skips are close to capacity the scrap may require more manual or crane assisted handling.

Figure 4 – Section Showing Tank Awaiting Dismantling & its Associated Ferrous Scrap Bin



Some similar arrangement needs to be devised for the loading of ferrous scrap into the railway wagons. Suggested in the figure below is a high dock loading facility for the railway wagons. Such a solution is assumed and the cost of its provision has not been taken into consideration.

Figure 5 – Section Showing Skip Lorry on a High Docking Facility



In order to realise the reduction process that is proposed certain other capital equipment is required: The equipment needed for the 160 man team, its modus operandi and its finance method are as follows:

> 2 x 20 wagon trains capable of holding 50 tonnes of ferrous scrap per wagon. One train would be in transit to the steel works while the other is loaded working on a two week cycle - leased.
> 1 x locomotive set to haul the train a 3,000km round trip to the steelworks - leased
> 1 x shunt locomotive for manoeuvring the train being loaded – assumed to be available locally at no cost apart from fuel.
> 2 x mobile cranes based on diesel trucks with a 20 tonne capacity for removing major items such as turrets etc – purchased.
> 2 x mobile cranes (possibly hydraulic) based on diesel trucks with a 5 tonne capacity for removing engines, gearboxes and minor items – purchased.
> 4 x skip trucks to empty skips into rail wagons – purchased.
> 28 – 30 skips for holding the various wastes. It is anticipated that the wear on these vehicles may be severe due to the hardness of the ferrous scrap from armour plate – purchased.
> 40 x oxyacetylene cutting sets - purchased
> A tanker each for spare diesel and other oils (which may provide a possible heat fuel source) – purchased.
> Assorted hand tools to aid dismantling – purchased.

To sustain the dismantling process an initial gas supply of 80 cylinders with equal numbers of oxygen and acetylene plus 20 spares is needed. The figures of gas consumption per tank is (at worst case) 1,400 litres of Oxygen and 400 litres of Acetylene. If we assume 8.7 m^3 capacity cylinders we will need approximately 13 cylinders of Oxygen and 4 cylinders of Acetylene per month.

Note that costs have been included to deliver the scrap ferrous material to the consuming steel works' gates (at an assumed rail distance of 1,500km). Note also that no provision has been made for the 160 men and their support staff by way of accommodation etc. It has been suggested that as with major civil engineering projects these workers might live on site in a separate accommodation and facilities area. This could be supplied in the form of a second train. Such localisation of the workforce would make the issues of security easier to deal with.

The Model Operation & Output

In operating the model some further assumptions had to be made. A key factor is the price the ferrous scrap will fetch at the steel works gates. Initially western prices were assumed but this led to unrealistically high levels of return. The reported outcome here anticipates a price of €100 per tonne.

The other area of difficulty was the process and calculation of payment to the squads. Here it was decided that provided an acceptable level of quality in sorting the scrap was maintained a direct proportion of the income realised should be paid to the men. This was set at 15%.

This led to the following output from the model:

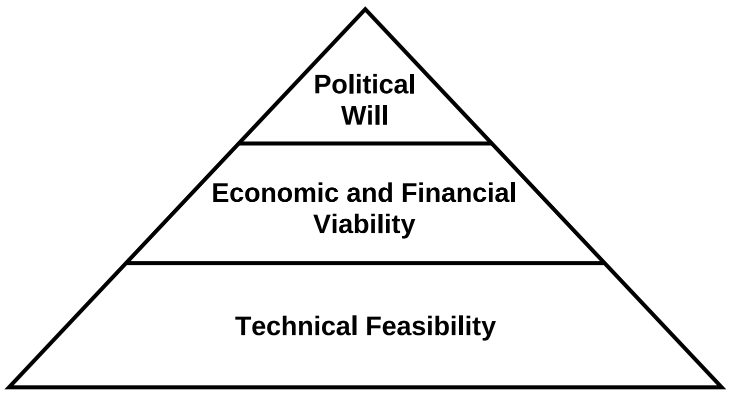
Per vehicle the cost of scrapping was approximately €2,550.

Per vehicle the realisable scrap value was calculated as €2,860.

These figures yield a profit margin of just under 11%.

Conclusions & Recommendations

Figure 6 – The Hierarchy of Provision for a Viable Solution



As the diagram above illustrates, a workable solution needs a sound technical base, realistic economic conditions and sound financial justification and finally the political will to carry it out.

- The markets for re-use and/or export are very limited. More than 95% of all vehicles would need to be disposed of by dismantling and the consequent recovery of their constituent raw materials.
- A practical production engineering process has been developed for the disposal of redundant heavy weapons systems in large numbers using technologies readily available in the Central Asian Republics.
- A necessary "one-off" financial provision will be needed to kick start the process. This will include the cost of setting up the dismantling equipment, site accommodation and other ancillary services. This cost is estimated to be of the order of €3m.
- Economic analysis of the process shows that it is viable for a ferrous scrap price of €100 per tonne.

- o The viability of the economic model depends on the liquidity of the scrap market. Should cash cease to flow, the process will stop.

In order to promote and explain the technical solutions proposed, a Technical Advisory Group has been formed from the key participants in the workshop and can be contacted through CENAA (Centre for European and North Atlantic Affairs) at the address on the back cover.

The remaining obstacle to the implementation of this project is the political will.

It is recommended that this report forms part of a proposal to the respective national governments and international bodies for the decommissioning and disposal of these redundant heavy weapon systems. The purpose of the proposal should be the establishment of the appropriate political climate in which to create the political desire to execute this programme.

ENDNOTES

[1] See for example http://www.currus.hu/angol/index.html
[2] Ibid.
[3] See http://www.vop025.cz/ for further technical information.
[4] For further details contact mjycenaa@yahoo.co.uk
[5] The man hour estimates are based on material presented to the first workshop by Col Jan Milas of VOP025.

This collection of papers is the result of a NATO Advanced Research Workshop (No 980919) held at Stupava, Bratislava, Slovak Republic in October 2004, and at the Economics University, Bratislava in January 2005. The workshop co-directors were Anne Aldis of CSRC and Miroslav Meciar of the Ministry of Economic Affairs, Slovak Republic.

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