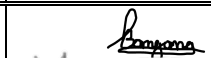
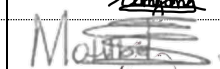
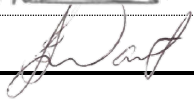
NW PlasGas project:

Hopper and screw feeder purchase specification

AC-NWPVR-SPE-20004

Revision: 1.1

Document Approval:

	Name	Signature	Date
Prepared by:	MR S MNGOMA		09/07/2021
Reviewed by	Mrs N.S. SELEME		2021/07/12
Approved by:	DR I.J. VAN DER WALT		2021/0709

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The revision history of the document is available in the DocMan System

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List of Acronyms & Abbreviations

The following acronyms and abbreviations are used in this document:

NW	Nuclear Waste
RFQ	Request For Quotation
rpm	revolutions per minute
TBC	To Be Confirmed
CD	Compact Disc
atm	atmosphere
PVC	Polyvinyl Chloride
PE	Polyethylene

1 INTRODUCTION

Solid compressible LLW needs to be pre-treated for it to be conveyed through the plasma gasification reactor inlet. In order to convey the feed material into the plasma gasification reactor, a blending hopper and screw conveyor is required.

The purchase specification will be used together with tender documents, and data sheet at procurement stage. RFQs will be sent to potential suppliers, who will supply the equipment.

The hopper/feeder should be able to convey ~ 1 to 3 cm diameter of different nuclear waste materials. Materials might contain metallic parts as well as glass. The feed material might also be moist and contain fine abrasive powder. Therefore the hopper/feeder should be mounted at a slightly downward angle.

The screw conveyer will be driven by an appropriate sized variable speed drive. The design will accommodate a 5 to 30 kg/h feed rate, force-fed into the gasification reactor.

The hopper will be able to contain shredded material from 4 x 210 l drums of solid compressible LLW. The hopper must seal air tight onto the shredder on the inlet (top) and onto the screw conveyer and reactor on the outlet. In addition the hopper will have flush gas inlet, temperature and pressure inlet ports.

2 Purpose

The purpose of this purchase specification is to provide details of the requirements for hopper/feeder supply of a fully functional equipment along with all accessories.

3 Scope of supply

The scope includes the supply of one hopper/feeder assembly, developing a quality control plan for the fabrication and assembly, sourcing materials of construction, fabricating and assembling the equipment in accordance with supplier's design specification and specification sheets (in Appendix A), testing, factory acceptance test, and delivering the equipment to purchaser's facility.

4 General requirements

The hopper and feeder assembly will handle feed material between 1 and 3 cm in size, and has a volume capacity of the 840 l (4 x 210 l drums) shredded compressible LLW material, fed at a rate range of 5 to 30 kg/h.

A shredder (AC-NWPVR-SPE-20003) will be attached to the blending hopper on the top end and a screw feeder, feeding the plasma gasification reactor on the bottom outlet end.

5 Hopper design

The hopper will be a gravity fed with a housing made of mild steel sheets 400x500x 8 mm. The length of the hopper will be 100 cm. It will have a width of 100 cm, and a depth of 100 cm. The discharge rate out of the hopper will range from 5 to 30 kg/h, and segregation of shredded material is not a concern for this hopper design. The hopper will have an opening size of 30 X 18 cm, which is equivalent to the bottom outlet of the crusher i.e. dimensions K & G indicated in figure 2 & 3 below. The hopper will receive various type of shredded waste of different particle sizes, with varying moisture content, which will include plastic gloves, paper, cloth, ceramics and light metals.

The shredded material may form a ball after being hand squeezed, and may not have flowing material properties. The shredded material will be made loose before it is fed to the shredder, and finally into the hopper, and it will not form a cake or time consolidate after it has been left unmoved for a longer time. The flow pattern in the hopper will be a mass flow type and not a core type of flow.

The hopper geometry selected is specifically focussing on the hopper angle and the outlet size. The geometry of the hopper will allow free flowing of the shredded material, and eliminate cohesion. The design method for this hopper design is based on a stress distribution model within hopper.

The hopper will be clamped to join all the four corners, and the bottom section housing the screw feeder.

The preferred hopper is a high flow hopper, purpose-built for screw conveyors, increases the flow of both free- and non-free-flowing bulk materials while eliminating or decreasing the amount of residual material in the hopper as well as the need for flow promotion devices.

The hopper will be designed with a steep back-wall and diametrically opposed side-walls having panel sections which are skewed outward on a horizontal axis, forming a trapezoidal area. The divergent angles reduce the ability of non-free-flowing materials to establish a bridge between the hopper sidewalls, instead causing material to topple and flow toward and down the steep backwall.

Figure 1 : High flow hopper

The hopper walls converge to form a trapezoidal inlet to the conveyor interface adapter which also employs shear planes and vertical walls, to direct material into a rotating screw.

The passive flow promotion attributes of the new hopper can eliminate the need for flow promotion devices such as vibrators and agitators.

The configuration shall reduce residual material in the hopper by 90 to 100 percent, depending on material flow characteristics.

The bottom of the high flow hopper will be bolted and fixed to a fixed horizontal screw conveyor.

6. Feeder design

The screw feed will receive mixed shredded material of varying moisture content at varying particle size, at varying gravity flows, and feed it in to plasma gasification reactor through a 50 mm diameter pipe.

The screw feeder will be made of mild steel or stainless steel and will be have a variable speed drive varying between 100 and 300 rpm, and capable of feeding at a range between 5 and 30 kg/h of radioactive waste. It will be driven by a 2 kW electrical motor, and it will have a conveying distance of 1 meter. The screw diameter will be 90 mm, and will have a pitch of 160 mm or whichever the supplier may recommend.

Figure 2 : Fixed horizontal screw conveyor

The top of the screw conveyor will be bolted to the bottom of the high flow hopper shown in figure 1 above, and the side outlet connected to the reactor via a custom made connector.

7. General

The general design philosophy of gravity flow storage of bin/feeder combination for controlling bulk flow of solid material will involves the following basic steps:

- Determination of strength and flow properties of bulk solids for the worst

likely conditions expected to occur during operation.

- Determination of the bin geometry to give the desired capacity.
- Estimation of loading exerted on the bin wall and feeder under operating conditions.
- An assumption should be made that gravity feed will provide a reliable form of shredded waste from the hopper bin.

8 Shedder assembly layout models

The technical specification in [8] above should be read together with the assembly models shown below:

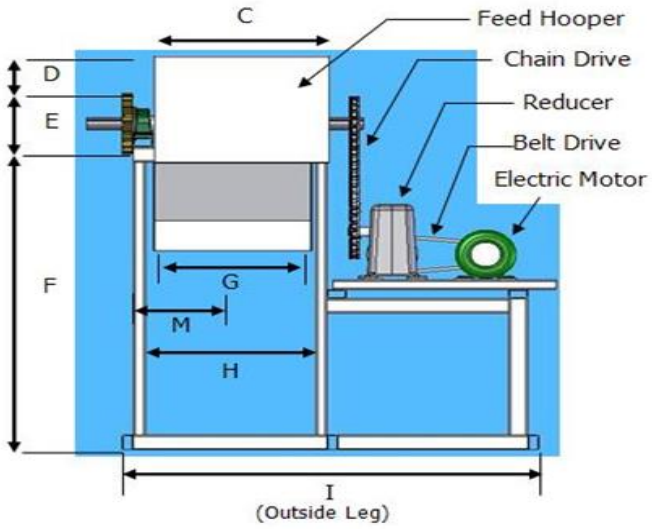

Figure 3 : Shredder side view

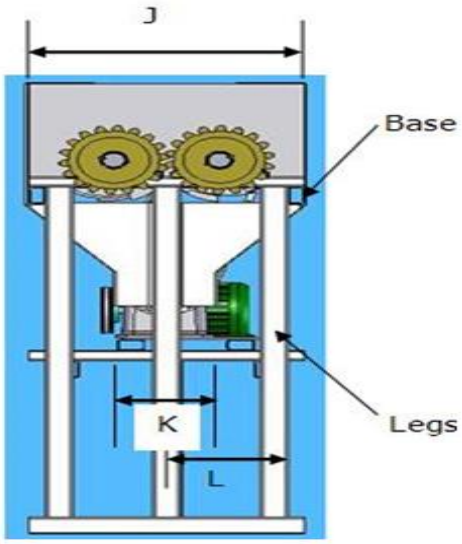

Figure 4 : Shredder front view

9 Qualification of bidder

The equipment supplier and their authorized representatives are eligible to participate in the bid. A recent and valid authorization certificate from the supplier for the supply of the shredder, hopper and the screw feeder must be attached with the offer. Essential qualification criteria for the bidder are as following:

- It is desirable for the supplier to be at least ISO 9001: 2008 / ISO 9001: 2015 (or latest) quality management system certified or its equivalent for design and manufacture of shredders, hoppers and screw feeders.
- The supply shall have at least five years of experience in design and manufacturing of shredders, hoppers and screw feeders.
- The bidder shall also submit the list of names of organizations where the supplier has supplied the shredders, hoppers and screw feeders. Offers not meeting these requirements will be treated as technically incomplete and may be rejected.

10 Shredder, hopper & screw feeder factory acceptance test

To conduct a functional test some brittle materials such as glass, polystyrenes, CDs, plastic file, extension cable socket will be fed to the shredder machine for shredding. A 160 litres to 210 litres drum filled with compressed general waste will

be emptied on the hopper, and shredded. The efficiency of the shredder machine will be determined by the average particle size produced by the shredding process. The shredding machine shall be cleaned and dried on completion of the factory acceptance test.

Appendix A

Hopper and screw feeder project specification sheet or data sheet

GENERAL DATA			
Item number	G1004 & C1005	Preparer	J.H. VAN LAAR
Revision number	0	Description	
Date	29 July 2020	**HOPPER with SCREW FEEDER**	
FEED PROPERTY DATA			
Feed description		Compressible Low Level Waste (CLLW): Cellulose 0.80 wt% PE 0.05 wt% PVC 0.15 wt%	
Fluid state		SOLID	
Density		~ 800 kg/m^3	
Viscosity		N/A	
Temperature	Maximum Normal Minimum	30 °C AMBIENT 15 °C	
Pressure	Maximum	1 atm	

	Normal Minimum	- 10 kPa (g) - 20 kPa (g)
HOPPER CAPACITY DATA		
Flowrate	Maximum Normal Minimum	30 kg/h 20 kg/h 10 kg/h
Power		2 kW
Opening size		500 x 500 mm
Capacity		20 kg
SCREW FEEDER CONSTRUCTION DATA		
Equipment type		Hopper with variable screw feeder
Screw diameter & pitch		90 mm, 160 mm
Rotating speed		Variable (100 – 300 rpm)
Process exposed material		Mild or Stainless Steel
Conveying distance		1 m
Notes:		

Approved By	Signed	Name	Date Page