

**NW PlasGas Project:
Shredder Hopper and Screw feeder
Purchase Specification**

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**NW Plas Gas Project:
Shredder Hopper and Screw Feeder Purchase Specification**

ENS-MES-SPE-0007

Revision: 1

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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
LLW	Low Level Waste
FAT	Factory Acceptance Test
PlasGas	Plasma Gasification
P&ID	Piping & Instrumentation Diagram

1 INTRODUCTION

One of the main objectives of the Nuclear Waste Plasma Gasification (NW PlasGas) project is to reduce the volume of the compressible Low-Level Waste (LLW) generated at Necsa through plasma gasification (PlasGas) technology. The objective is to build a volume reduction system that will not only reduce the volume and weight, but also destroy the non-contaminated matrix and thus rendering uranium recovery from the residue economically viable, and the final residue possibly non-radioactive. The solid waste resulting from the entire Necsa site will be shredded, blended and gasified to significantly reduce its volume. 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 are required.

The purchase specification will be used together with tender documents, and data sheet at procurement stage. A Request for Quotation (RFQ) providing all requirements for the acquisition of the shredder, hopper and screw-feeder will be sent to potential suppliers, who will supply the equipment.

The feed-hopper and screw-feeder should be able to convey smaller than 3 cm diameter of different LLW waste materials received from a shredder. The feed material will be moist and could also contain fine abrasive powder; the hopper and screw feeder should therefore 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 20 kg/h feed rate, force-fed into the gasification reactor via a screw-feeder. The storage-hopper should be able to contain material to be shredded from a 100 litre plastic bag of solid compressible LLW. The shredder must be a seal airtight via two 10 inch spool pieces (item 4, Figure 1) fitted with a flanged 10 inch ball valve (item 5, Figure 1) in between, connected to the top of the feed-hopper i.e. on the inlet. The feed-hopper will be connected to a screw feeder (item 12, Figure 1) via a 4 inch flange. The screw-feeder will be contained inside a 4 inch pipe, and will be horizontally mounted, and will terminate or end with a 4 inch class 150 flange, where the plasma reactor flange will be connected.

2 Purpose

The purpose of this purchase specification is to provide details of the requirements for a shredder, feed-hopper and screw-feeder to be supplied as an assembled unit for the NW PlasGas project.

3 Scope of supply

The scope of work for the supplier includes the following:

1. To design, manufacture, and supply one shredder, a feed-hopper and a screw-feeder assembly.
2. Develop a quality control plan for the fabrication and assembly of the three equipment
3. Source the materials of construction, fabricate and assemble the equipment in accordance with their design specification and specification sheets provided in section 6 of this document.
4. Test the assembled equipment in a factory i.e. a factory acceptance test (FAT) shall be performed prior to delivering the equipment to purchaser's facility at Necsa in Pelindaba.
5. Test the assembled equipment on site i.e. a factory acceptance test (SAT) shall be performed after the delivery of assembled equipment at purchaser's facility i.e. at Necsa in Pelindaba.

4 General requirements

The feed-hopper and screw-feeder assembly will handle shredded feed material smaller than 3 cm (outlet shredded material delivered by the shredder) in size, and will have a volume capacity of 1,6 m³ shredded compressible LLW material, fed at a rate range of 20 kg/h.

A shredder (item 3, Figure 1) will be connected to the top end of the feed-hopper via a 10 inch flanged pipe with a 10 inch fanged ball valve. The bottom end of the feed-hopper will be connected to a screw-feeder pipe via horizontal butt welds, welded along the top of the 4 inch horizontal screw feeder pipe. The outlet of a screw-feeder will connect to a plasma reactor via a 4 inch class 150 flange. The screw-feeder will be mounted on horizontally on a frame and connected to the plasma reactor.

5 Shredder

With reference to the P&ID attached in Appendix B, the shredder assembly must include a shredder (G1201), together with a storage-hopper (B1203). The assembly must provide a horizontal female threaded connection point for a level transmitter (LT1203A), and a horizontal female threaded connection point for an equalising line (15-12-APCG-04) on the shredder hopper.

The storage-hopper and shredder assembly (item 3, Figure 1) will have a 10 inch diameter class 150 flange attached to the bottom of the shredder. Another 10 inch class 150 flange will be connected to the top of the feed-hopper flange. The storage-hopper and shredder assembly, should be able to close tight enough to ensure that no fine material can leave this storage-hopper during shredding. The airlock to be fitted by Necsa on top of the storage-hopper should be able to close tight enough to ensure that no fine material can leave this storage-hopper during shredding.

Note that the supplier will fabricate and supply two 10 inch spool pieces (items 4, Figure 1), 185 mm long each that will have a 10 inch full bore ball valve fitted between the two spool pieces. One end of the 10 inch pipe spool piece will be connected to the bottom of the storage-hopper and

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shredder flange, via a 10 inch class 150 flange. A 10 inch class 150 flanged ball valve (item 5, Figure 1) will be connected on one end on the 10 inch pipe spool flange. Another 10 inch pipe spool will connect the 10 inch valve to the 10 inch flange, which will be welded on top of the feed-hopper (item 6, Figure 1), as indicated in Figure 1 below. The feed-hopper will have a capacity of 1,6 m³. The spool pieces and valve assembly will be included in the quotation and will form part of the shredder, feed-hopper and screw-feeder assembly scope of work.

The shredder will receive various types of un-shredded waste material of different particle sizes, with varying moisture content, which will/could include plastic, rubber gloves, paper, cloth etc., but exclude ceramics and light metals.

Note that a 242 litre airlock will be designed, supplied separately and fitted by Necsa. It will be fitted on top of the storage-hopper after delivery of the shredder, hopper and feeder assembly.

The shredder shall have minimal or no vibration, small enough not to cause the airlock to open during the shredding process. In the event of vibration, this must not lead to the development of leaks or excessive wear-and-tear around the airlock/shredder assembly.

The supplier will design, fabricate, and manufacture the supporting structure, which will have stairs, that will allow the operator to reach the top of the 2,2 m high assembly, and load bag-full of material to be shredded. The supporting structure shall be fabricated in a way to allow it to be bolted onto the floor, to ensure that it is rigidly secure and fastened, where it will be installed.

A sketch of a shredder, feed-hopper and screw-feeder is shown in Figure 1 below, indicating high level dimensions of the equipment.

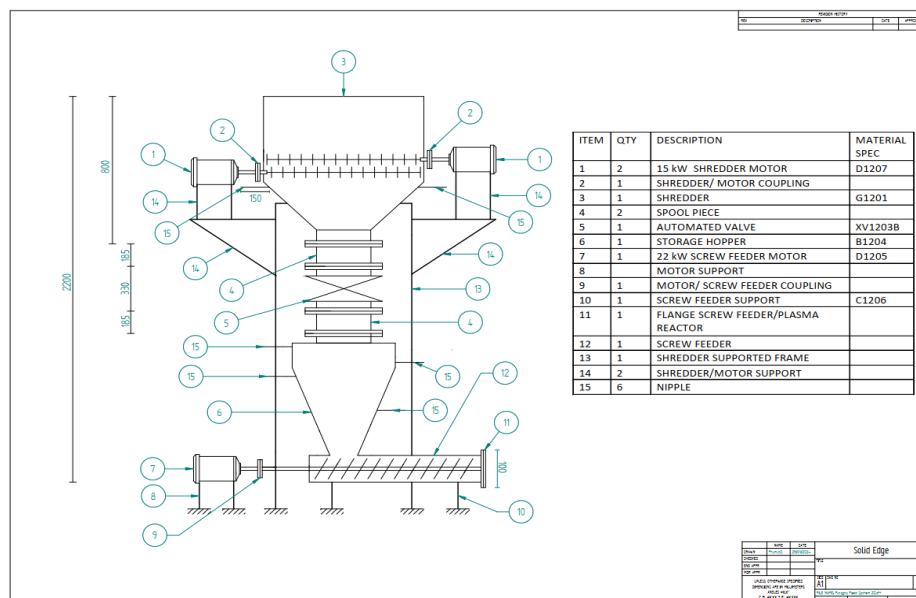


Figure 1 : Shredder, feed-hopper and screw-feeder 2D sketch

Note that the final dimensions for the shredder, feed-hopper and screw-feeder assembly will be determined by the supplier, but it is recommended by the client for the whole assembly to have an overall height of 2,2 m as indicated on the sketch in Figure 1 above.

6 Shredder specification

The shredder will have its own material receiving hopper called a storage-hopper, which will be one assembly with the shredder. The shredder shall be supplied with a control box that has automatic reverse and forward function to aid in unblocking a potential blocking/stoppage of the shredder. The control box supplied with the shredder shall be compatible to work and programmed with the Beckhoff PLC. The shredder reverse mode shall provide at least five cycles of reverse modes to unblock itself, before the blockage can be manually removed by an operator.

The shredder shall be supplied with two cutting elements / blades preferably having two separate electric motors and gearboxes to reduce the risk of blockage/stoppage by rotating at different speed during shredding, and during the auto reverse cycle.

The shredder shall be fitted with a “W-type” of a screen below the cutting elements/blades, with a clearance small enough for the cutting elements/blades to pick-up particles larger than 3cm, and throw it back into shredder for further shredding. The screen shall only allow particles smaller than 3cm to pass through to the feed-hopper. See Figure 2 below showing shredder cutting elements/blades.



Figure 2: Shredder cutting elements/blades

The shredder shall be supplied with 6-10 mm (range) thick cutting elements/blades fitted with two gearboxes that can provide a torque high enough to be driven by two 30 kW (combined) powered electrical motors.

All materials of construction for all shredder components shall be specified by the shredder supplier.

Part name	Part dimension
Width base	Supplier to specify

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Length base	Supplier to specify
Hopper length	Supplier to specify
Hopper depth	Supplier to specify
Weight	Supplier to specify
Machine H.P.	Supplier to specify
Shredding speed	Supplier to specify
Shredding capacity	Supplier to specify
Chain length (If applicable)	Supplier to specify
Shaft diameter	Supplier to specify
Shaft material	Supplier to specify
Spur gear pitch diameter	Supplier to specify
Speed reducer gearbox ratio	Supplier to specify
Electrical motor	Supplier to specify
Downward force applied on shaft	Supplier to specify
Cutting blade material	Supplier to specify

7 Storage hopper

With reference to the P&ID number attached in Appendix B, the feed-hopper (B1204) will be gravity fed with a housing made of mild steel sheets. The feed-hopper shall be 1,6 m³ in capacity, and its discharge rate shall be 20 kg/h. The feed-hopper will receive various type of shredded waste of different particle sizes smaller than 3 cm, with varying moisture content, which will/could include plastic (PVC, PP, nylon, PE, etc.), gloves (latex, nitrile, rubber, leather etc.), paper, cloth (jackets, pants, overcoats etc.), wood, rubber insulation etc., but excludes ceramics and light metals.

The feed-hopper should be supplied with combs to prevent the formation of balls. The shredded material should not form a ball to improve material flowing properties.

The feed-hopper geometry selected shall specifically focus on the hopper angle and the outlet size. The geometry of the feed-hopper shall allow free flowing of the shredded material, and eliminate cohesion. The preferred feed-hopper shall be a purpose-built for a screw feeder to increase the flow of both free, and non-free flowing bulk materials while eliminating or decreasing the amount of material in the hopper.

Note that the final dimensions of the feed-hopper and screw feeder will be determined by the supplier, who will design the equipment.

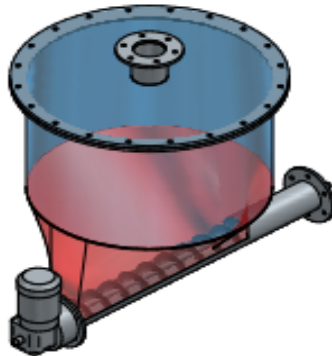


Figure 3 : Feed-hopper and screw-feeder assembly

The feed- hopper shall have a passive flow promotion attributes that can eliminate the need for flow promotion devices such as vibrators and agitators. An example of a high flow feed-hopper and screw-feeder assembly is shown in Figure 3 above.

8 Screw-feeder

The screw-feeder will receive mixed shredded material of varying moisture content at varying particle size, at varying gravity flows, and will feed it into a plasma reactor through a 4 inch internal diameter pipe. The end of the screw feeder shall be connected to a 4 inch plasma reactor class 150 flange via a 4 inch class 150 flange.

The screw-feeder materials of construction shall be selected by the supplier, however the Necsa preferred material of construction is mild steel and. The screw-feeder will have a variable speed drive varying between 100 and 300 rpm, and capable of feeding at a rate of 20 kg/h of contaminated shredded waste material. The screw-feeder will be driven by a (5-10) kW electrical motor (supplier to advice), and will have a conveying distance of 1 meter. The details of the screw feeder are indicated in Figure 4 below.

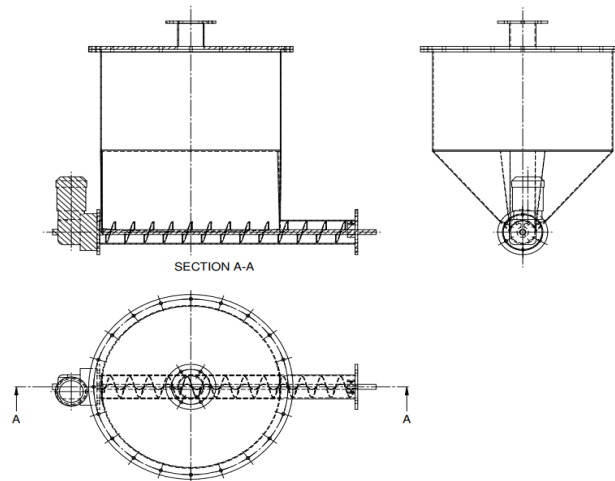


Figure 4 : Fixed horizontal screw-feeder with a 4 inch horizontal feed flange

The screw-feeder shall feed finer particles to the reactor smaller than 3cm with a heap density of 98 g/L.

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 follows:

- Supplier shall follow ISO 9001: 2015 (or latest) quality management system (or equivalent), certified for the design and manufacture of shredders, hoppers and screw feeders.
- The supplier 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 similar equipment.

Offers not meeting these requirements will be treated as technically incomplete and will be rejected.

10 Shredder, hopper and screw feeder factory acceptance test

To conduct a functional test, a 160 litres to 210 litres drum filled with compressed general waste will be separated in a glovebox, solid material will be loaded into plastic bags. Solid material, suitable for shredding will be emptied into the shredder, and be shredded. The efficiency of the shredder machine will be determined by the average particle sizes smaller than 3 cm, produced by the shredding process. The shredding machine shall be cleaned and dried on completion of the factory acceptance test.

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Appendix A

Hopper and screw feeder project specification sheet or data sheet

PROCESS SPECIFICATION SHEET	
GENERAL DATA	
B1204, C1206	Preparer CJH Venter Chief Process Engineer
1	Description
5 September 2023	HOPPER with SCREW FEEDER AND DRIVE
FEED PROPERTIES DATA	
Feed description	Compressible Low Level Waste (CLLW): Cellulose 80 wt% PE 5 wt% PVC 15 wt%
Fluid state	SHREDDED SOLID - PARTICLE SIZE OF APPROXIMATELY 3 cm BY 3 CM AND SMALLER
Heap Density of shredded material	~ (100 - 150) kg/m ³
Viscosity	N/A DOES NOT FLOW EASILY.
Maximum	30 °C
Normal	AMBIENT
Minimum	15 °C
Maximum	10 kPa(g)
Normal	- 5 kPa (g)
Minimum	- 10 kPa (g)
STORAGE HOPPER CAPACITY DATA	
Maximum	30 kg/h
Normal	20 kg/h
Minimum	10 kg/h
Opening size	Supplier to specify
Capacity	242 litres
SCREW FEEDER DATA	
Flow Rates	Maximum 30 kg/h
	Normal 20 kg/h
	Minimum 10 kg/h
Equipment type	Hopper with variable speed screw feeder
Drive Power	To be advised by the Supplier

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Screw diameter & pitch	90 mm, 160 mm
Rotating speed	Variable (100 - 300 rpm)
Process exposed material	Mild Steel
Conveying distance	1 m
Notes: This fluid does not flow easily and will be tempted to form blockages where it leaves the hopper and goes into the screw feeder. It is therefore crucial that the hopper outlet does not taper too much to the screw feeder.	

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Appendix B

Shredder, hopper and screw feeder P&ID

