FMO Sinter Test Grinder HVAC Exhaust Modification

ISNATT – International Society of Nuclear Air Treatment Technologies, Inc.

32nd International Nuclear Air Cleaning Conference

Michael Sulva, P.E.
GEH – New Units Engineering ESBWR
Wilmington, NC

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A Joint Venture of GE, Toshiba, & Hitachi

GNF – Fuel Manufacturing

- Global Nuclear Fuel – Americas, LLC (GNF-A) is a Fuel Fabrication Facility which fabricates pellets enriched to less than or equal to 5 weight percent U-235
- Location: Wilmington, NC
- USNRC License: SNM-1097
- Docket No. 70-1113
- 10CFR70 – Domestic Licensing of Special Nuc Material
- Integrated Safety Analysis (ISA) identifies process hazards associated with Fuel Manufacturing
- Items Relied On for Safety (IROFS) are identified for each accident sequence that could fail to meet the requirements of 10CFR 70.61

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FMO Sinter Test Grinder HVAC Exhaust Modification

Develop a modification of the system and establish the design bases for the new exhaust system design.

Additionally, the hood design needs minor changes to ensure proper airflows are channeled to the grinder wheel head. This will ensure grinder particles generated are predominantly removed via the grinder wheel (swarf) exhaust. i.e Copy the Production Hood

Update all applicable procedures and design documentation.

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Design Parameters

Nuclear Criticality Safety –
Geometry, Mass, Moderator

Grinder Details – 3 connections
Hood Exhaust, Swarf/Grinder Exhaust, Enclosure

Air Flow Requirements –
Grinder / Swarf Flow
Hood Flow

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Design Parameters

Particulate Parameters (Swarf)–

- **Concentration**
- **Particle Size**
- **Particle Weight**

Collection Canister

- Capture device max. 25kg

Radiological Monitoring

Accountability Monitoring

HEPA Filter Monitoring

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Conclusion Discussion from Early Design Meetings, Vendor recommendation and Best Practices

1. The **Cyclone** or **High Efficiency Centrifugal** collector are often used for this application
2. The **Fabric Filter** or **Self-cleaning Fabric Media Collector** is often employed in this application.
3. Since moisture would affect "moderator" negatively this system will NOT employ any **Wet Scrubber**.
4. **Electrostatic Precipitators** will not be employed with the medium / larger particle size; however the Apitron originally employed this principle in combination with the self-cleaning fabric HEPA filter.

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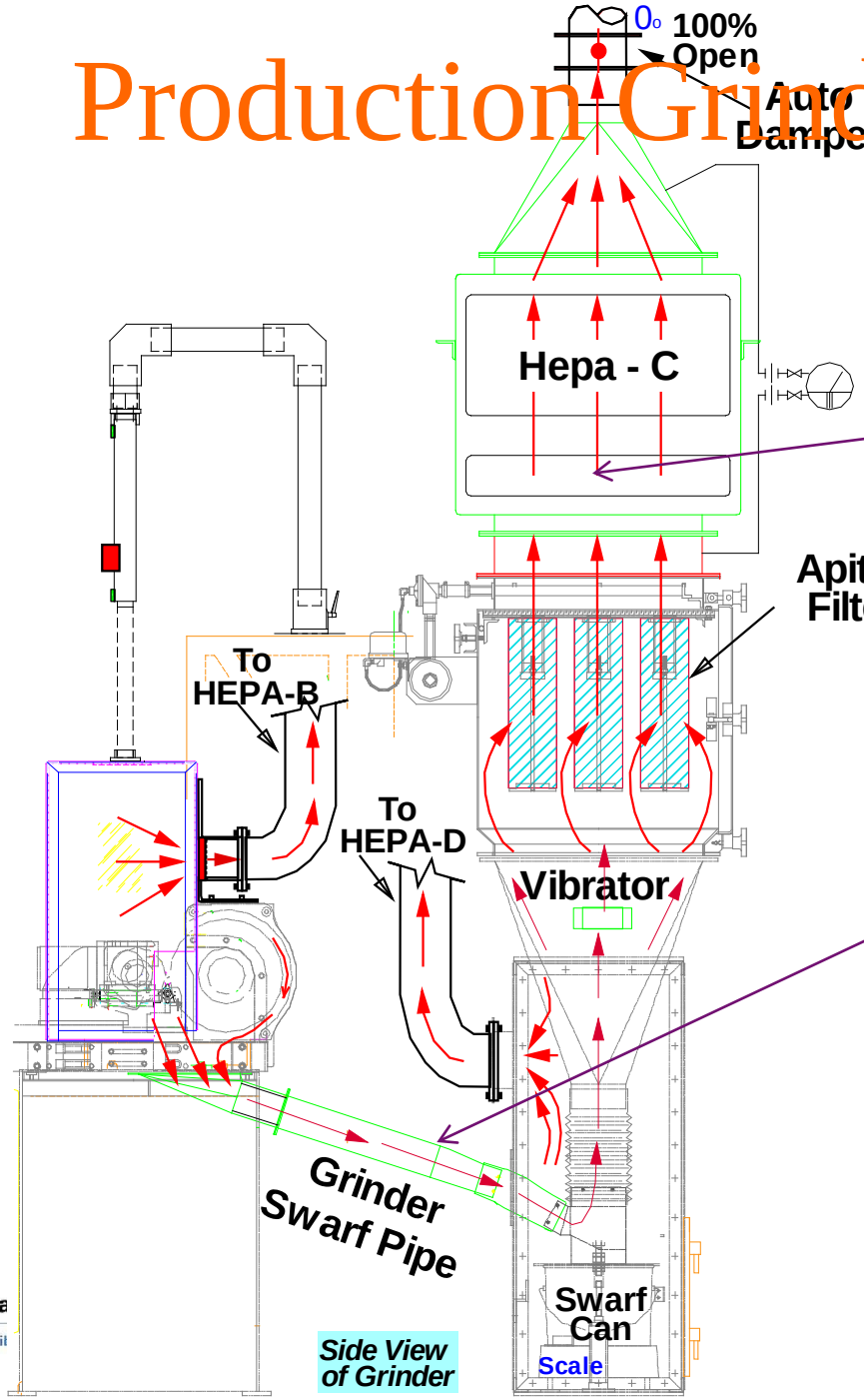
Production Grinder Setup



Particle Size uniform
< 3 microns

Particle Size non-uniform
0.5 – 50 microns

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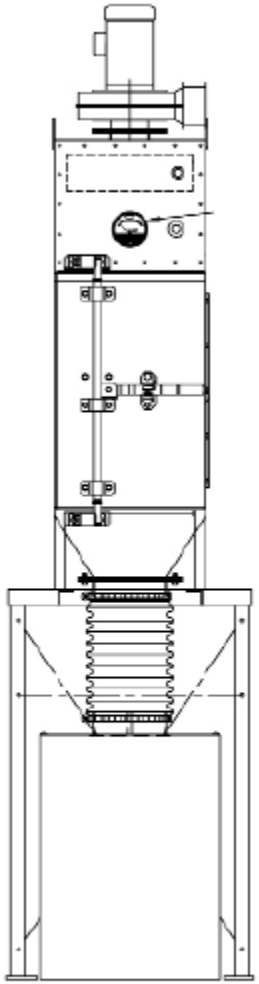
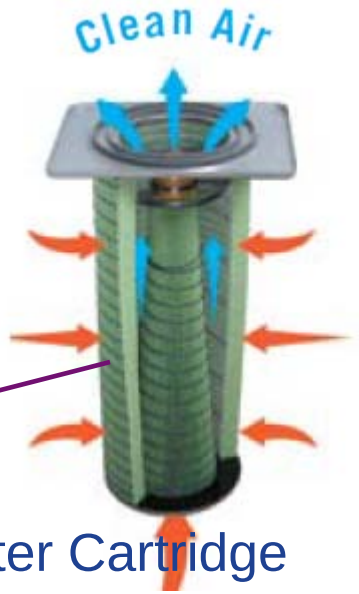
One Vendor



55-gal Drum Discharge Configuration

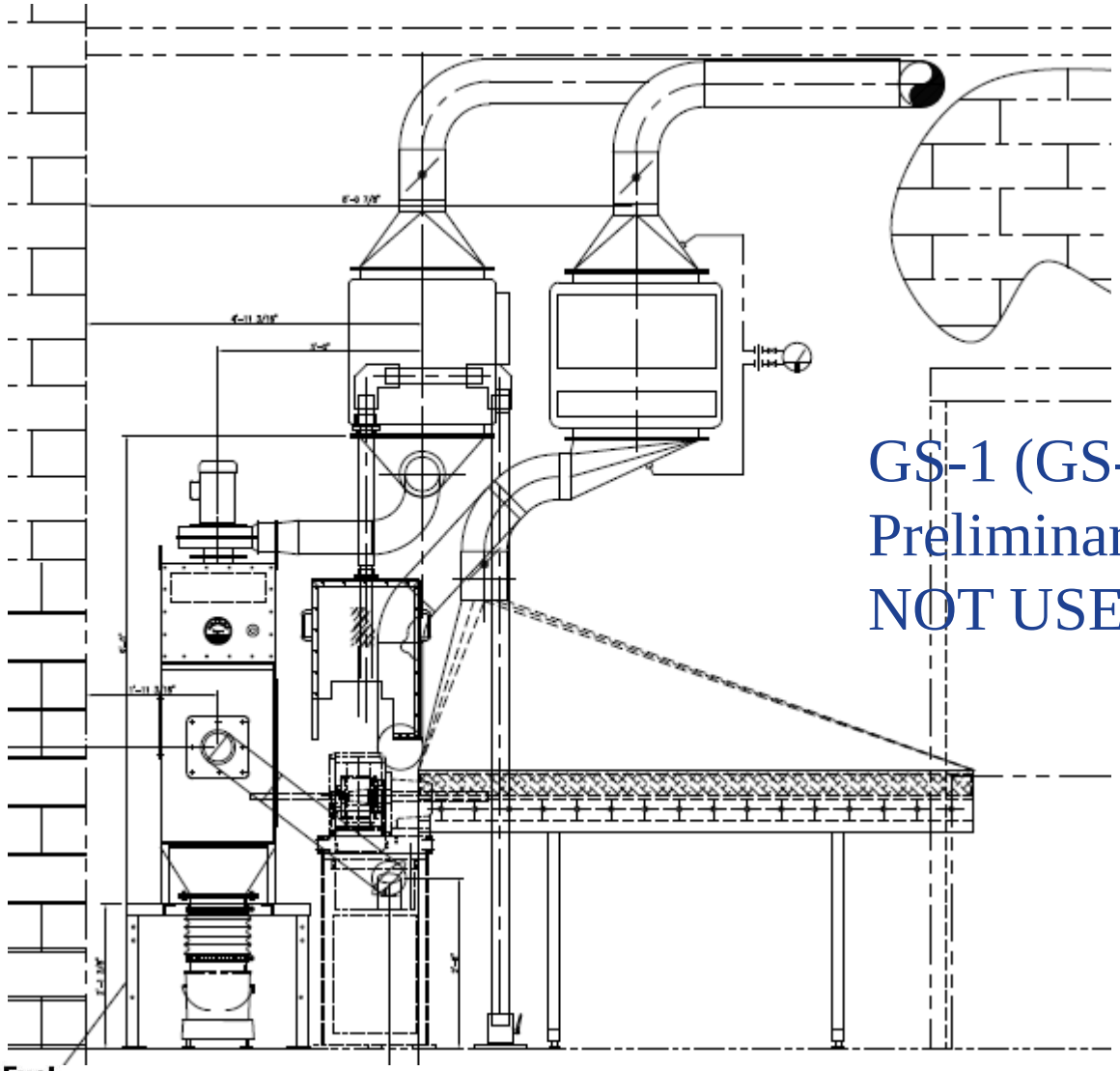
GS-Mini – early design



Filter Cartridge

Optional Automatic Timer Cleaning System

Dust Collector in System



GS-1 (GS-Mini)
Preliminary Design
NOT USED

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Camfil-Farr GSC1 Dust Collector

Gold Series® offers modular design for optimum flexibility–delivered fast!

"We are very happy with the Farr Dust Collector. The dust collection solution was purchased for our CNC plasma cutter to replace a horizontal cartridge dust collector due to short filter life. The current filters have been in for over a year and still look great and are operating on less than 3" pressure drop. Also, the Farr people have been a pleasure to do business with."

— Dan Schuler, Schuler Manufacturing

High Entry Inlet
Cross flow is created through the filters. Eliminates upward "can" velocities associated with traditional hopper inlets.

Gold Series® Features

- Modular design for optimum flexibility–have it your way fast!
- Each module accommodates airflows up to 5,000 cfm
- Module constructed of 7 gauge carbon steel
- Door, hopper, inlet and panels are all 10 gauge steel
- Powder painted for unsurpassed corrosion resistance
- Component configurations are virtually unlimited
- Vertical design of cartridges enables efficient pulse cleaning of dust

Looks Like a Safe Because It's Built Like a Safe

Optional Quick Open View Port in Hopper

Powerful Cleaning System to Provide Long Filter Life

Pulse Discharge of Gold Cone® Filter

Individually Powder Coated
Gold Series components are individually powder coated prior to assembly for superior corrosion resistance.

FDC Controller

Automatic Filter Cleaning
The Farr Dust Collector (FDC) Controller's flexible design allows it to be adapted to many dust collector configurations.

Easy Filter Change-out

Camfil Farr GS-1

Camtrain contained dust collection system

Bag In / Bag Out for dust at collection drum and Cartridge Filter

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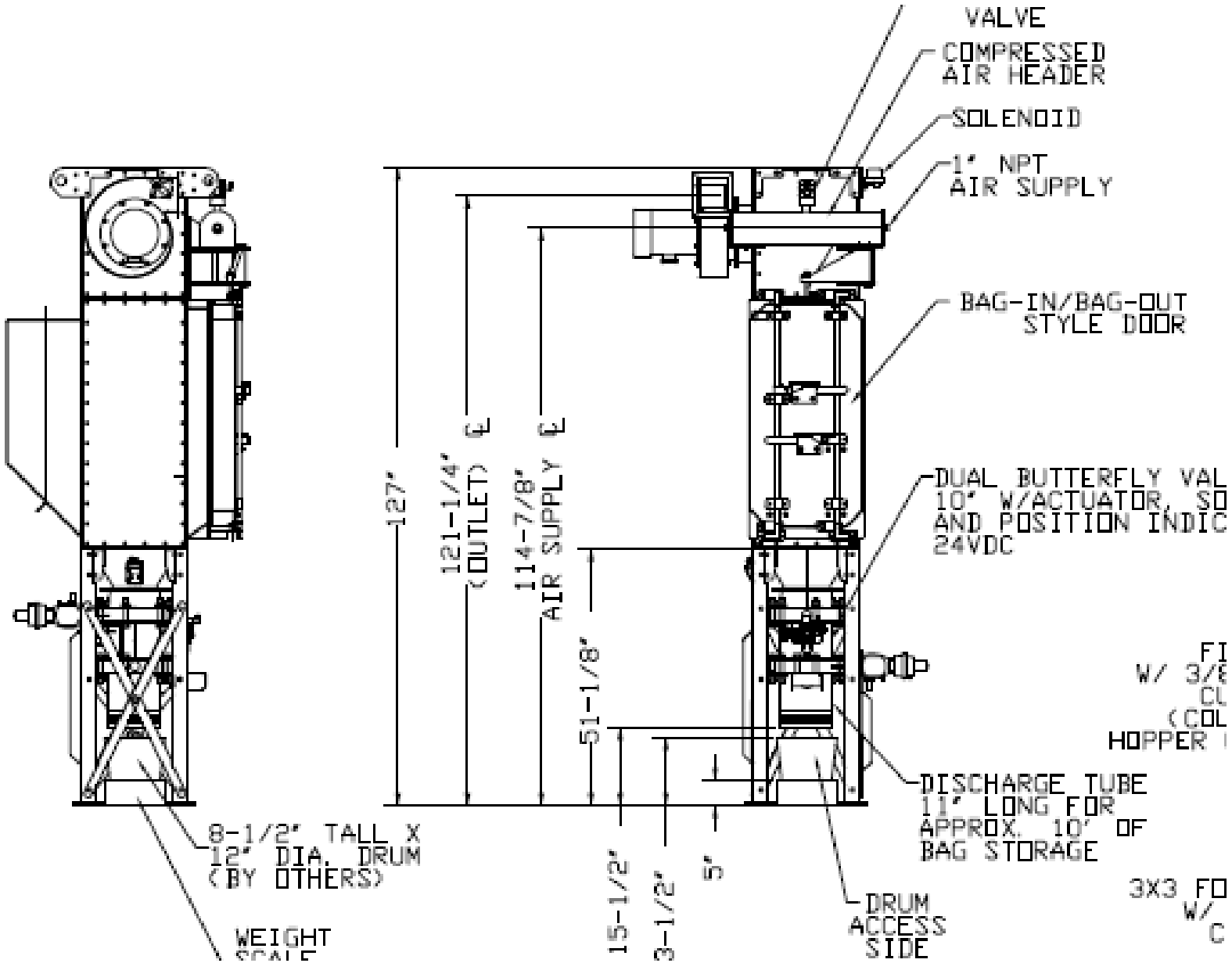
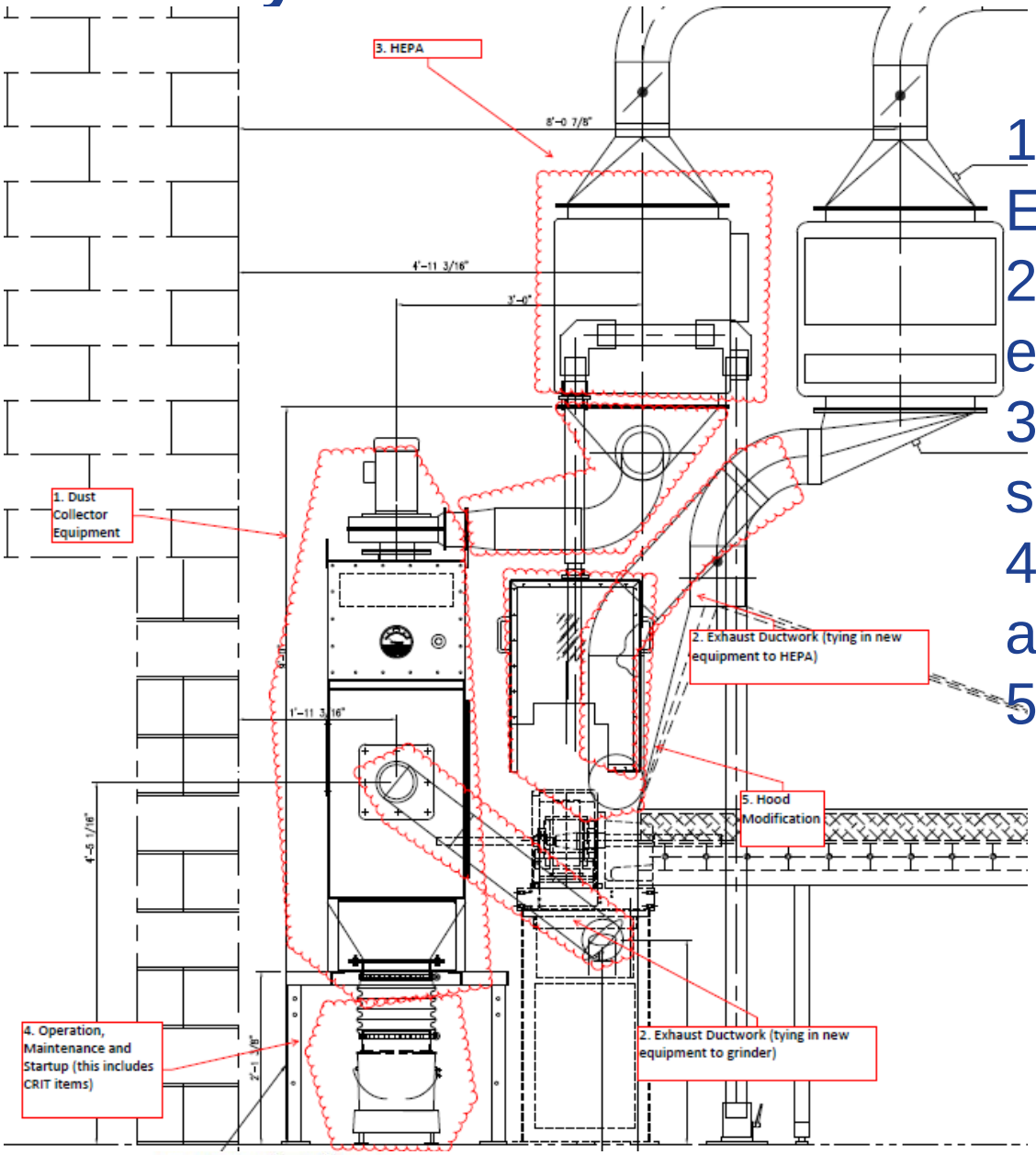
Camfil-Farr GS-1 Dust Collector GNF



New System Discussions



1. Dust Collector Equipment
2. Exhaust Duct (new equipt to grinder / HEPA)
3. HEPA – The existing setup
4. Operation, Maintenance and Startup, CRIT
5. Hood Modification

Dust Collector Design Criteria

Handout

NEW DUST COLLECTOR UNIT Key Design Criteria	1. Dust Collector Equipment 2. Exhaust Duct (new equipt to grinder / HEPA) 3. HEPA – The existing setup 4. Operation, Maintenance and Startup, CRIT 5. Hood Modification	Purchase Specification	CR Installation Detail	Startup Testing	Operation / Maintenance Procedure	CRIT Analysis	NOTES
Swarf Collection System Design is Inadequate - Causal Factor #2	1						HOW Camfil-FARR design meets Criteria
Unit equipped with (or can be configured with) measurements, alarms, grinder shutdown capability and control panel with: 1. Differential Pressure (for pulse cleaning blowback, alarm, and s/d) 2. Weight of 3 gallon can (scale or load cells) 3. Timer for blowback (set for xx mins operation) 4. Downtime clean (goes thru pulse cleaning cycle when it is s/d) 5. Can "In-place Switch" 6. Filter locked "In-place Switch"	1	Y		Y			Unit will be specified with these requirements to ensure they are met. Testing will ensure design meets those specified. i.e Do NOT want Backflushing without can in-place OR Don't want to operate grinder if Filter is not locked in place… See Operational Logic Sheet
New Design includes transition to GNF standard 3 gallon can AND leaktight connection with NO dust leakage during changeout	1	Y			Y		GNF's std 3 gallon can will be the repository of the swarf in an ~~airtight bag~~ Apirton nearly identical configuration however without exposure to the collector internal pressure since use of 2 valves will operate when dumping swarf to ~~bag in~~ the can
Footprint of Collector favorable for easy Maintenance (filter changeout, ect.) & will not impact Operation	1	Y	Y				The Camfil-FARR design was the most favorable footprint. The addition of the valves and moving the HEPA atop the collector increased overall height and inventor modeling of the unit was needed.
Ensure unit is manufactured under QA acceptable program AND if performance testing needed	1	Y					The unit is test rated to 6.5 psig. QA Program is ISO 9001 ????
Failure modes are clearly understood, can be easily detected and pose no CRIT risk 1. Use of 3 gallon can on scale 2. Suction and Disch (if used) Duct round and <6" dia. 3. Dust can't collect other than in filter and can 4. Failure modes are "fail-safe"	1, 4	Y				Y	CRIT early analysis indicates that any of the proposed units will meet an analysis. It will just be what controls are required by the Analysis - D. Eghbali
Failure modes are clearly understood, can be easily detected and pose no Rad risk 1. Loss of Fan 2. Loss of Main (System) Exhaust Negative Pressure	1, 4				Y		Preliminary look by RP indicates design of BI/BO for filter and 3 gallon can removal identical to Apitron can removal system, are desirable ~~reasonable - Tony Priest~~The use of a collector fan was aborted Post Peer Review 2-12.
Filter and 3-gallon can changeout should be easily performed without uranium dust leakage i.e. B_{in}/B_{out} (Bag-In / Bag-out) feature or other	1, 4	Y	Y	Y	Y		Post Peer Review Design established enclosure around 3-gallon can.
Geometry of Filters in New Unit meets CRIT analysis requirements	1, 4		Y			Y	See Above
Differential pressure monitoring not effective due to small particle size and process charicteristics (airflow?) Causal Factor #1	3						HEPA dP monitoring threshold was based upon a historical dP with particle spectrum being only small particles.
Established dP Monitoring of HEPA's needs to be effective - 4" dP therefore New Dust Collector Filter Efficiency needs to be >=Alpitron efficiency to ensure the particle spectrum effluent of the new system can effectively be equivalent to the historical 4" data	1, 3	Y					Gold Cone Filter - efficiencies up to 99.99%; MERV 15/16. This will ensure that the downstream HEPA is exposed to an extremely small particle spectrum. The quantity exposed over time will be only 0.01% of the total particle mass sent to the collector. The cartridge has a filter failure alarm which would detect any blowby.
							While all Collectors come with Fans to keep flow constant, this

Dust Collector Operation

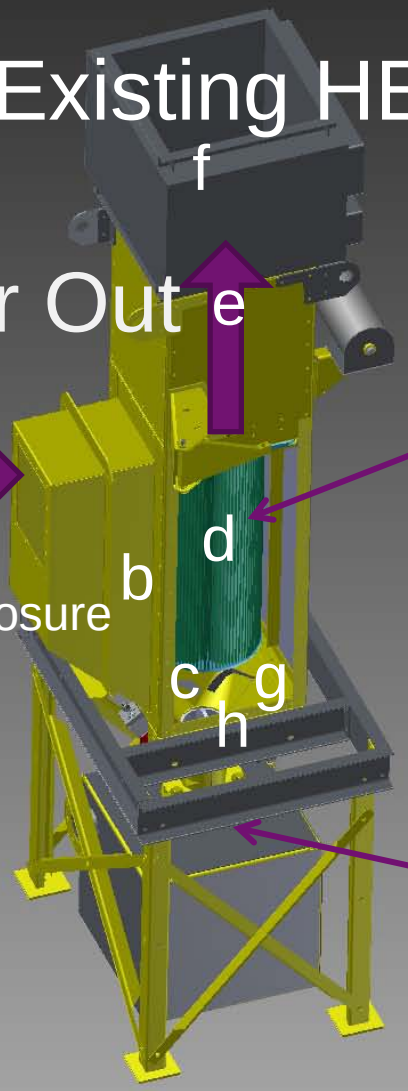
Existing HEPA

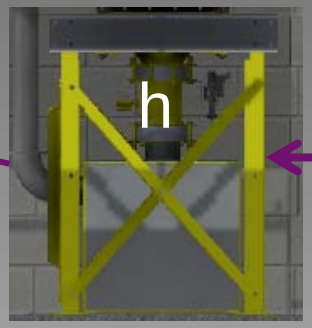
Cartridge Filter

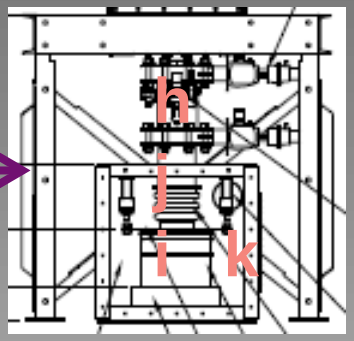
Clean Air Out

Dust in

1. GrinderSwarf
2. 3-gallon can enclosure
3. Grinder Hood



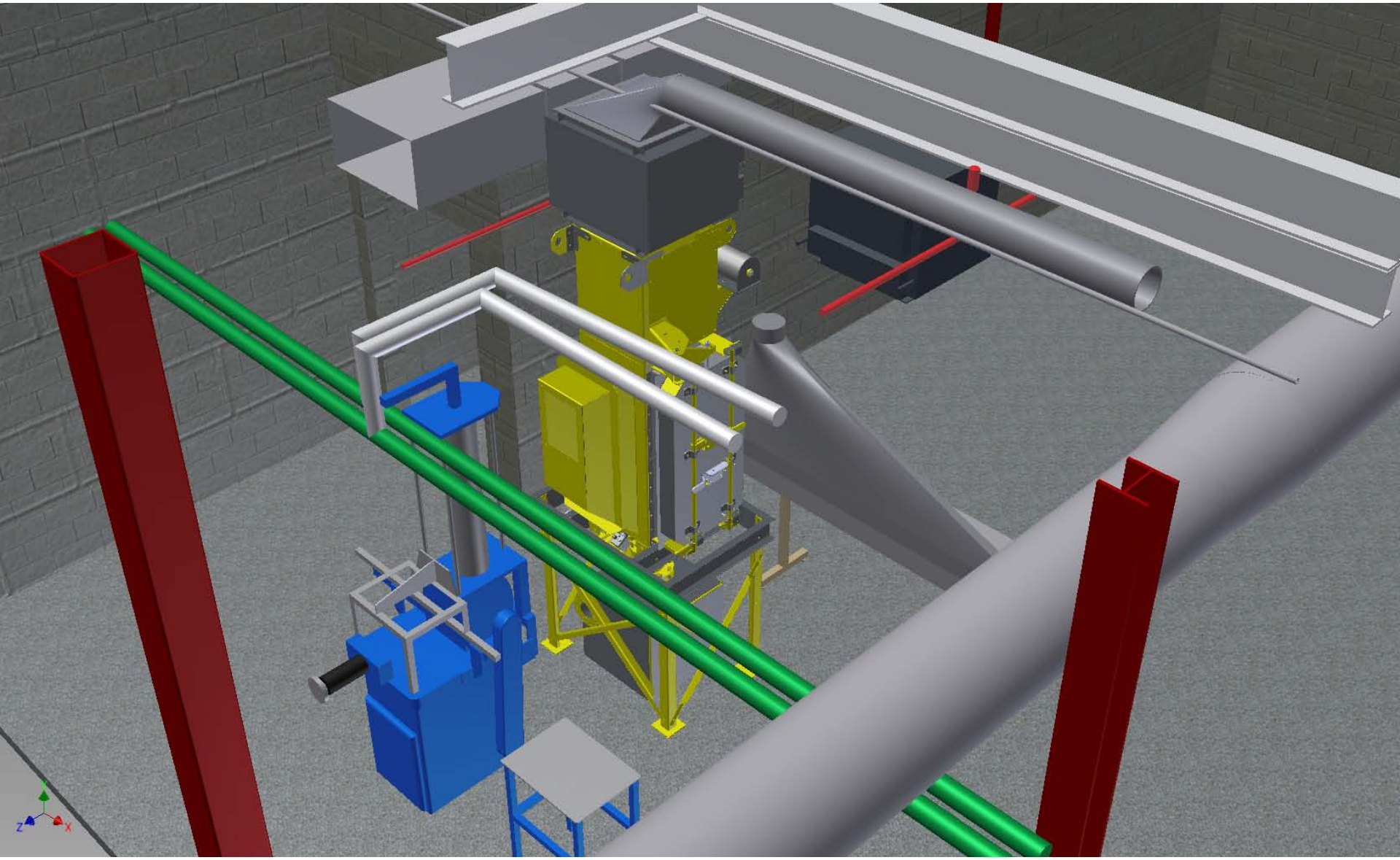




System Operation

a. The dust laden air comes into the unit at a high velocity ensuring there is no settling out within the ductwork (swarf tube, grinder table, or enclosure).
b. The collector is designed to drop the velocity of the air to allow settling out to occur with the direction changes and inlet baffles.
c. The dust which settles out of the dirty air drops down to a 60 degree slope, polished surface, hopper, polished to preclude bridging from occurring.
d. The dust entrained within the air passes onto the outer surface of the cartridge filter where 99.99% (MERV 16) of particles >0.5 micron by weight are captured
e. The cleaned air (CA) is then free to pass up the inside of the cartridge filter and out of the unit via the clean air plenum of the dust collector.
f. This CA with 0.01% residual particles passes up and is captured onto the downstream HEPA filter.
g. The cartridge filter is periodically pulsed back to remove captured dust and allow it to settle down the hopper.
h. The bottom of the hopper are 6” butterfly valves in series. These valves periodically cycle (open-closed but never both open at once) to allow the dust to fall down first into the space between the valves then into the 3-gallon can. There are 2 vibrators to facilitate dust falling when valves cycle open. As a backup, there are 2 level sensor in this area for measurement of potential excess dust.

Dust Collector in System



Conclusion Discussion

The dust collector will meet:

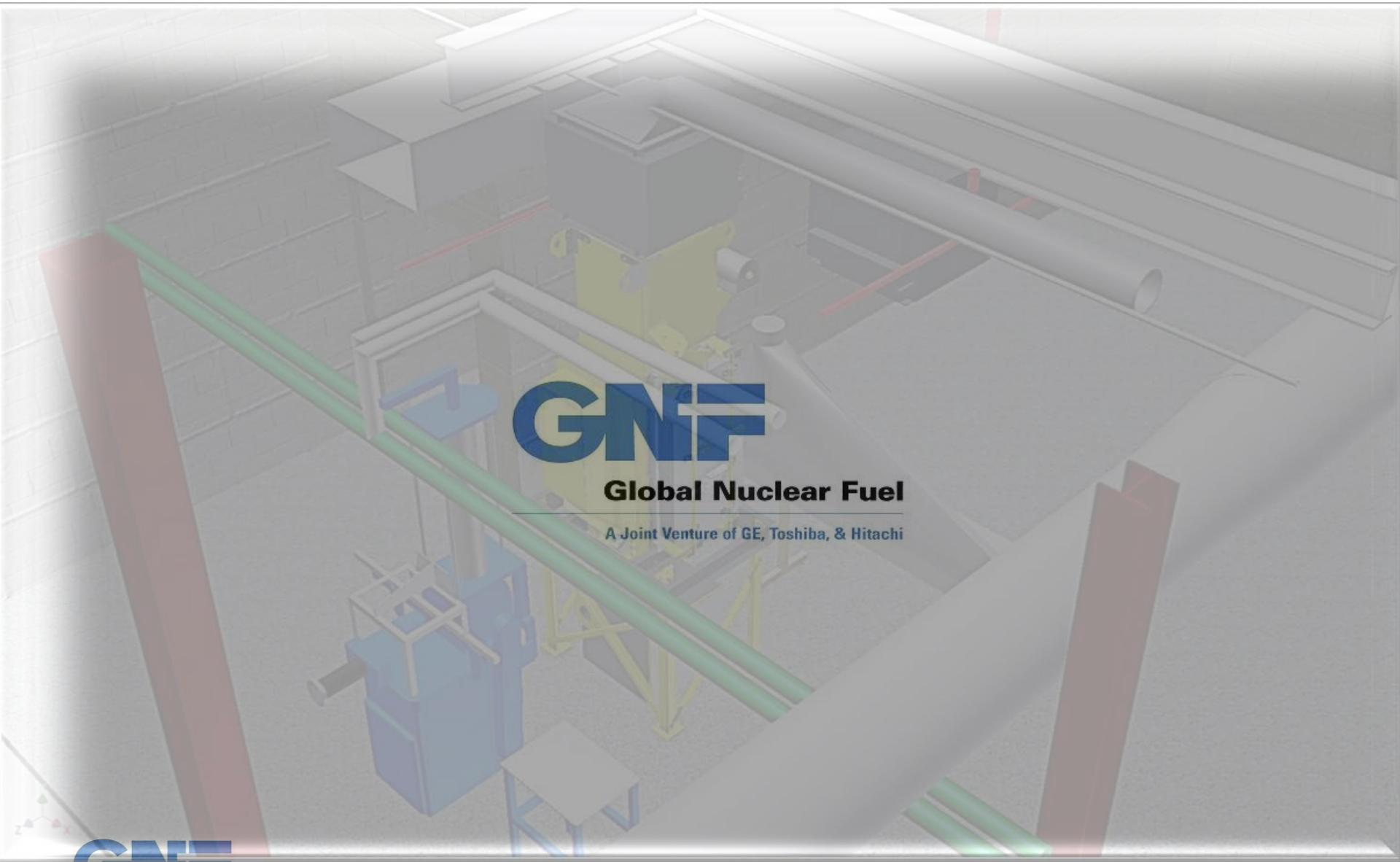
a. Nuclear Criticality Safety
   - Backup level / vibration and dP sensors
   - Favorable geometry for assumed max dust collected

b. Air Flow Requirements (600 cfm at 6” w.g.)for the:
   - Grinder Exhaust Flow Requirements
   - Grinder Hood & Enclosure

c. Ductwork Air Flow velocity / max sizing (6”)

d. Low Differential Pressure with alarm and grinder s/d

e. Collection requirements
   - 3 gallon can w/ enclosure on scale
   - Automatic Pulse Cleaning w/N2
   - Solid housing w/support leg structure
   - Door, hopper (polished 60º slope), inlet and panels 10 gauge steel
   - Bag In / Bag Out for filter change out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