

# Summary of the Transport System for the Near Detectors

## Discussion topics

- Transport system - General Description
- Transport system - Movement Devices
- Transport system - Unknowns & Mockup
- Transport system - speeds/times/acceleration



# General description

- Unmanned, remote control movement
- Movement max speed is 10.2 cm/min, after 60 minutes of accelerating to that speed.
- Deacceleration is also spread over 60 minutes.
- The distance traveled between stops is approximately 4 meters, total travel of 30.5 meters.
- The return trip may have different stop locations, but accelerations and speeds will remain the same.
- The stop locations will vary run to run.
- The movement cycle will repeat every two weeks for 15 years.
- Use a series of roller chain type “skates” and support rails to move heavy machines to be used to move liquid filled detectors used in experiments.
- Movement is powered by electric motors and gearboxes within skate.
- The detector weight is 900 tonnes with a 20 tonne horizontal side moment load.

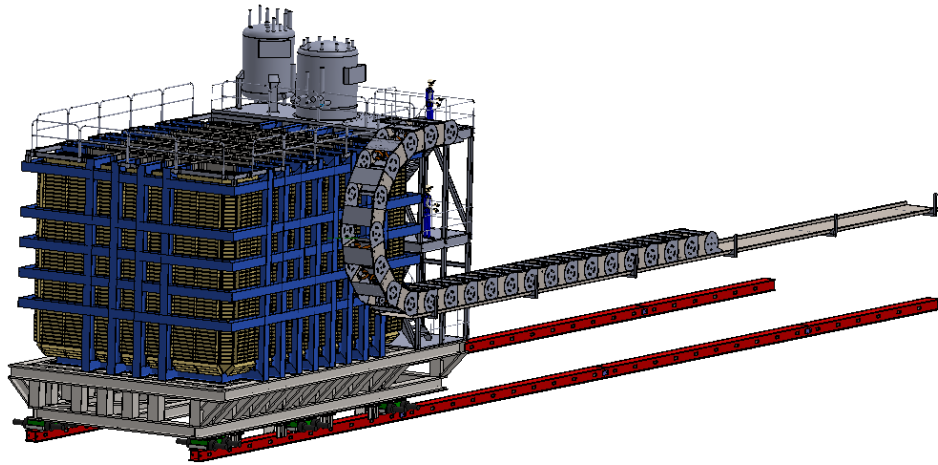


# General description

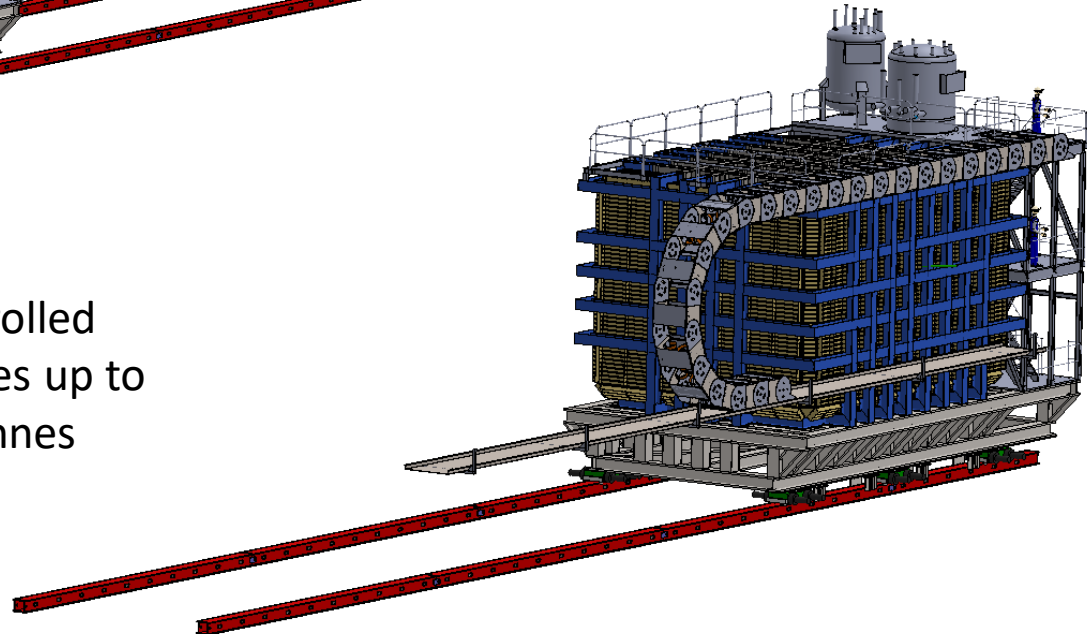
Desired total travel is within 8 hours

- 1 hour preparation at the beginning and at the end
- 6 hours remain for travel time
- Average speed is 8.5cm/min over 30.5m
- 9 stops within the 30.5m are planned, actual locations to be flexible per run
- Repeatable stop locations within +/-1cm needed; +/-1mm desired
- A round trip may take 2 weeks

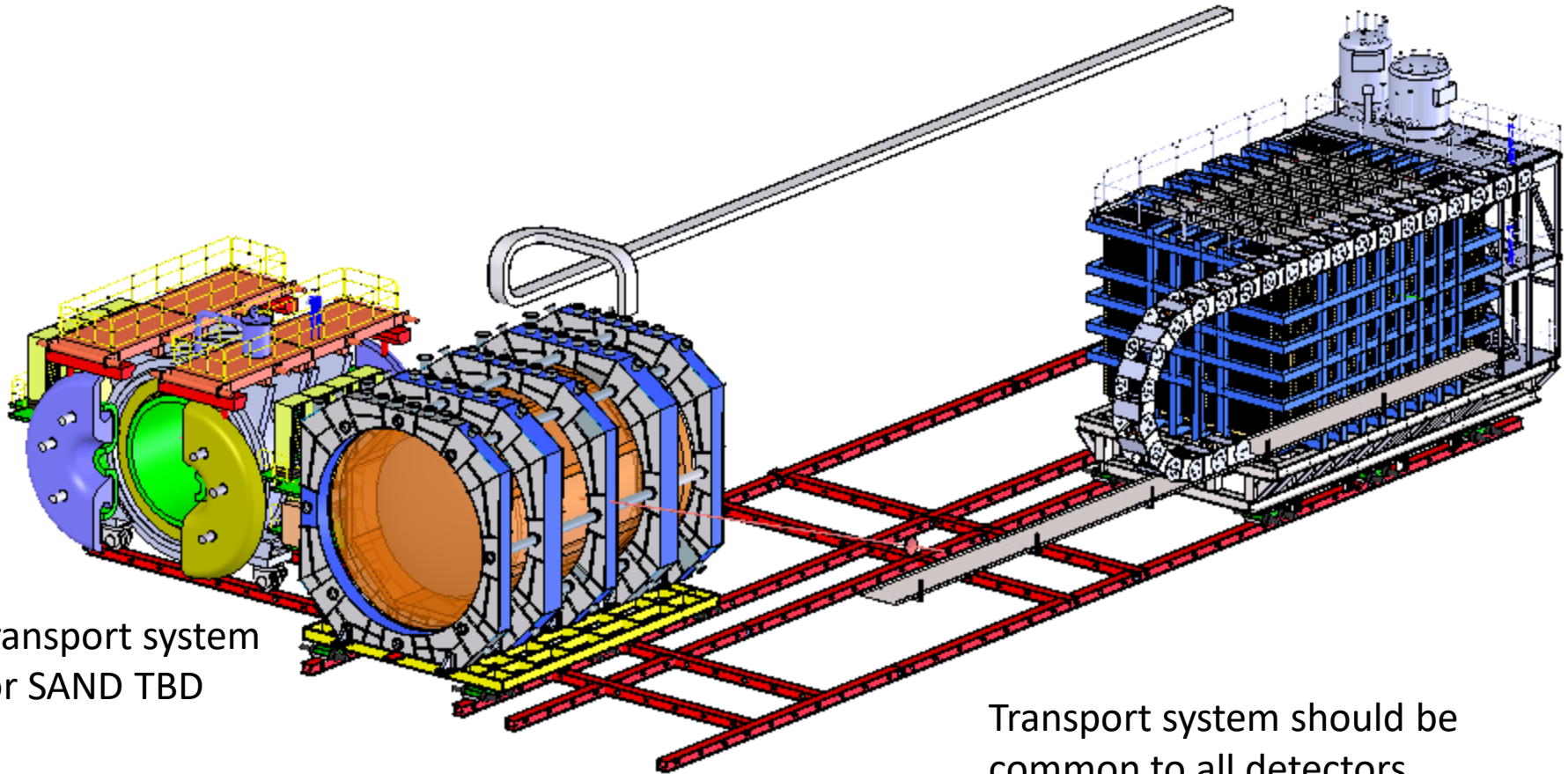




Slow, smooth, and controlled movement over distances up to 30.5m and carry 900 tonnes



# Commonality



Transport system  
for SAND TBD

Transport system should be  
common to all detectors

# Transport System Devices

Use Hilman Powered rollers to move detectors

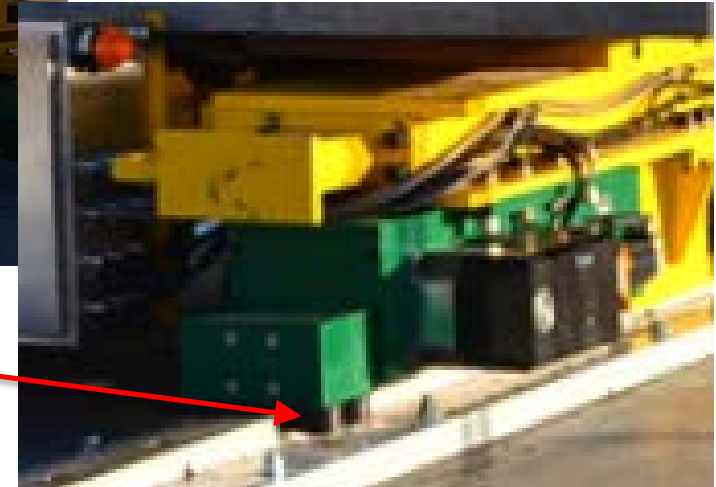


This example shows (6) 100 ton electric motorized roller assemblies moving a 400 ton test load at 1 ft/min for a nuclear waste conversion plant. Our loads are higher and speeds slower.



# Transport System Devices

Use Hilman Powered rollers to move detectors



Guide rollers at the 4 corners are sufficient to handle the 20 tonne side loads

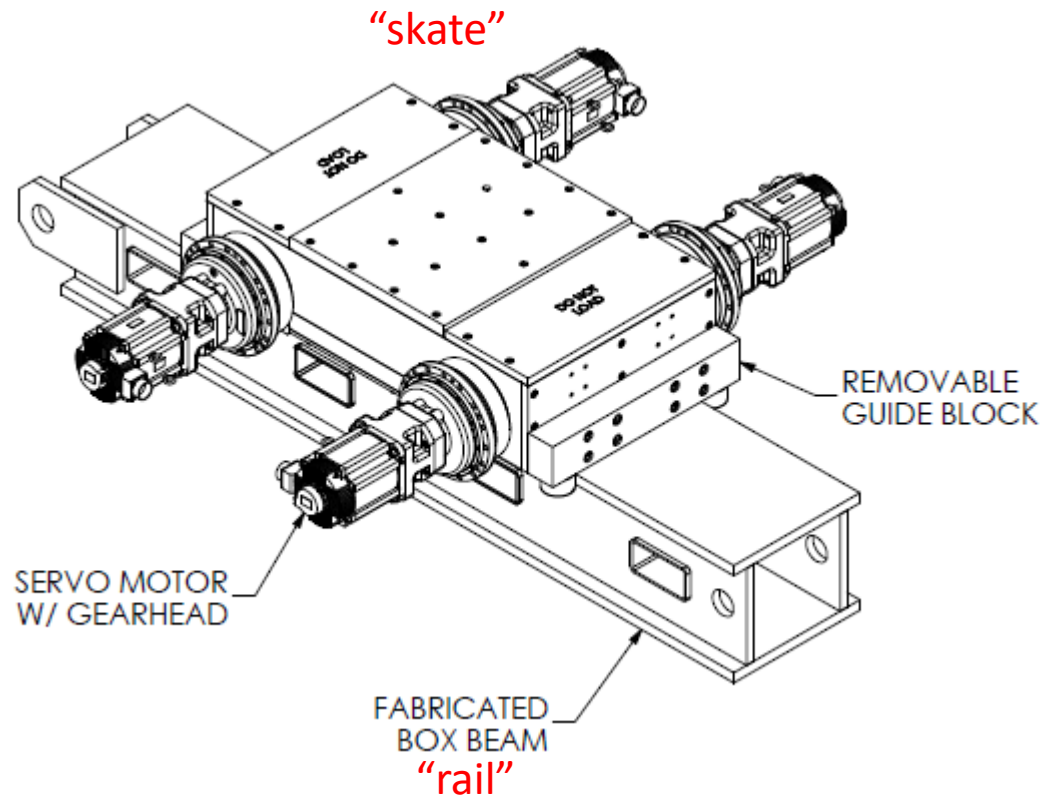
# Hilman skates are common

- Non-powered Hilmans are used through out FNAL and other labs for heavier loads than we need to move
- There are several manufacturers of the non-powered skates, but only Hilman has the powered version, and its patented.
- Using a linear gear system (Rack & Pinion) would not be a smooth movement system
- A powered Hilman should be the choice, but limits us to a single vendor





# Powered Hilman skate



Hilman 200 Tonne capacity unit

# Determining Location along rails

## Current thoughts

- Use a rotary encoder
- Driven by a rack mounted to the rail & a pinion gear on the encoder
- Mount in a protected location below floor level
- Attach encoder to a Hilman
- Encoder output sent to control room



# Unknowns

Does motion create sloshing within a detector?

Potential vibration sources-

1. From skates
2. From skate to rail interface
3. From energy chain
4. Other unknown sources

Rail cleanliness an issue?

Other issues?



# Mockups planned

Expect many future discussions on the following:

1. Considering needs & goals
2. Considering a scaled model
3. Determine if & how fluid sloshing can be modeled
4. Need to establish time schedule
5. Need to establish costs



# Plans for Hilman

- Hilman initially quoted \$885k and a 20 week delivery for (6) 200 Tonne units, rails, and motor control system; per detector movement system
- One system would be used for each detector
- Using a system under SAND is TBD

## Future plans

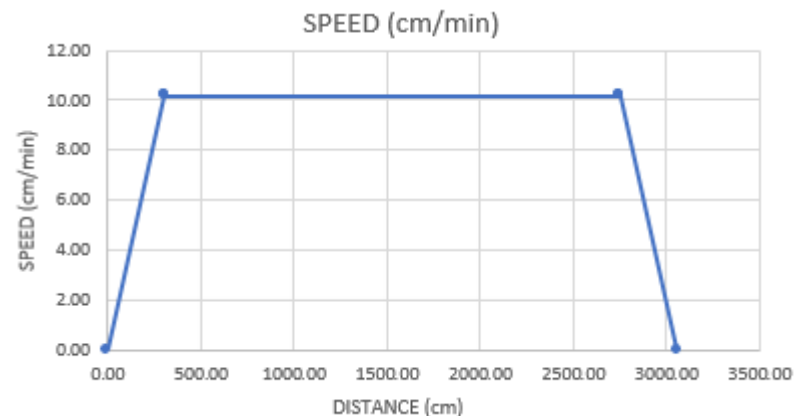
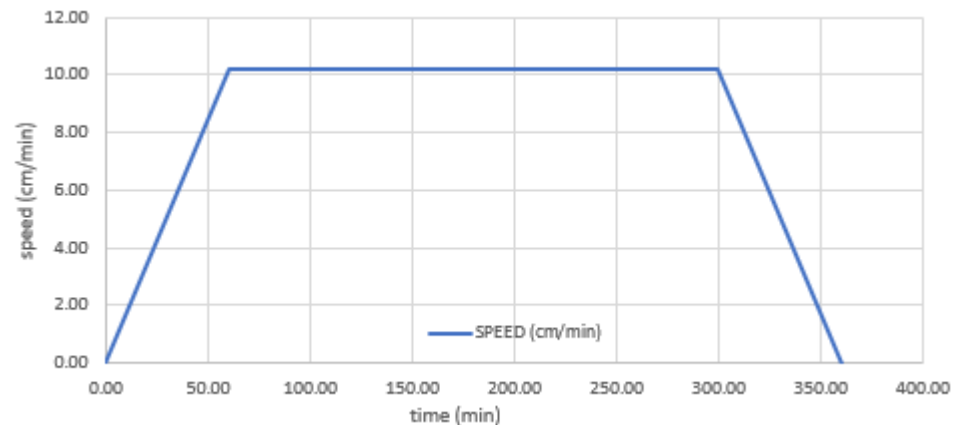
- Visit Hilman in NJ
- Better understand the details of their proposal
- Refine specs, requote, etc
- Order a system for mockup trials



# Transport system movement speeds

- Curves calculated using motion equations
- Speed-time-distance charts for 30.5m travel within 6 hrs
- Acceleration works out to be  $0.17\text{cm/sec}^2$

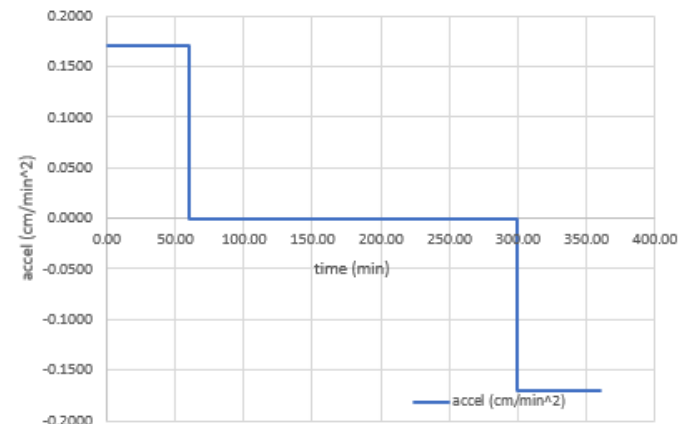
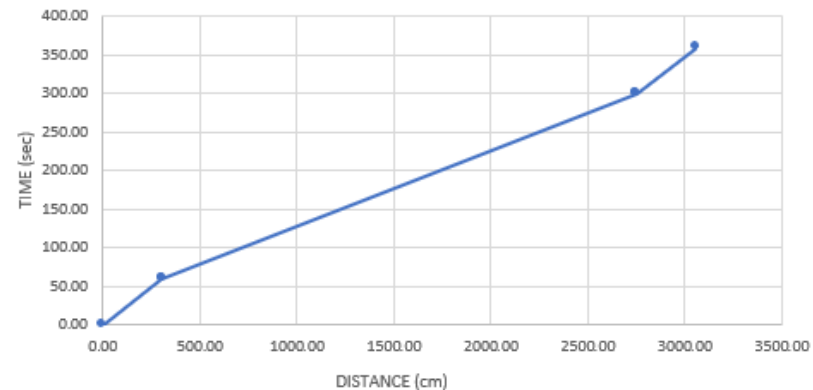
DATA POINTS							
DISTANCE (cm)	0.00	306.00	306.00	2754.00	2754.00	3060.00	DISTANCE (cm)
SPEED (cm/min)	0.00	10.20	10.20	10.20	10.20	0.00	SPEED (cm/min)
TIME (min)	0.00	60.00	60.00	300.00	300.00	360.00	TIME (min)
accel (cm/min <sup>2</sup> )	0.1700	0.1700	0.0000	0.0000	-0.1700	-0.1700	accel (cm/min <sup>2</sup> )



# Transport system movement speeds

- Curves calculated using motion equations
- Time vs distance
- Acceleration curves
- Charts for 30.5m travel within 6 hrs
- Acceleration works out to be 0.17cm/sec<sup>2</sup>

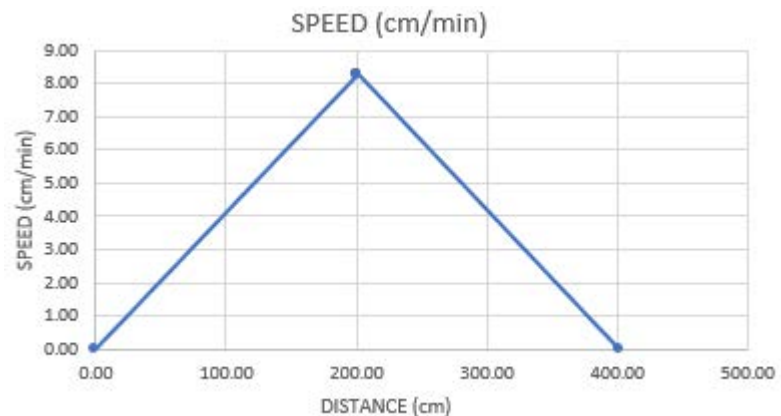
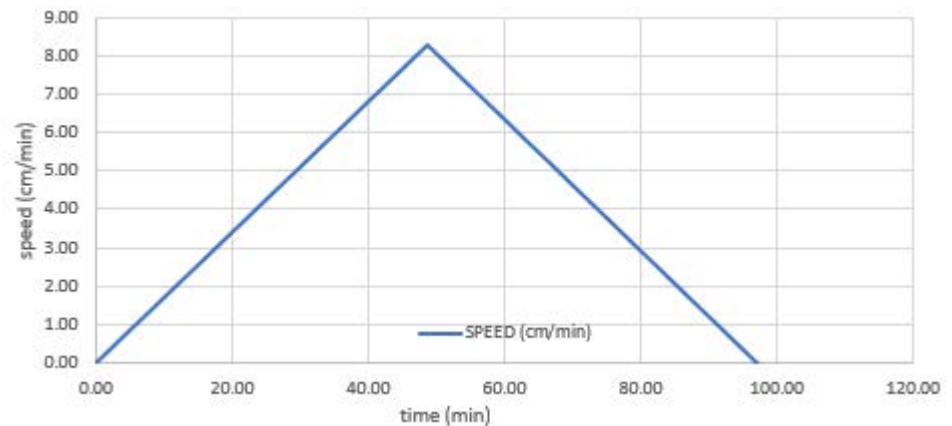
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accel (cm/min <sup>2</sup> )	0.1700	0.1700	0.0000	0.0000	-0.1700	-0.1700	accel (cm/min <sup>2</sup> )



# Transport system movement speeds

- Speed-time-distance charts for 4m travel within 1.6 hrs
- 9 stops along 30.5m travel. Flexible locations TBD
- Acceleration remains at  $0.17\text{cm/sec}^2$

DATA POINTS						target= 400cm within 1 hr
DISTANCE (cm)	0.00	200.77	200.77	200.77	200.77	401.53
SPEED (cm/min)	0.00	8.26	8.26	8.26	8.26	0.00
TIME (min)	0.00	48.60	48.60	48.60	48.60	97.20
accel (cm/min <sup>2</sup> )	0.1700	0.1700	0.0000	0.0000	-0.1700	-0.1700





# Discussions

