Diesel Particulate Filters

The Safe Approach to a Project

CVRD Inco Limited has been an active partner in DEEP and involved with several diesel emission initiatives since 1995.

We continue to investigate efficient reliable DPF's that will provide a cleaner environment in our work places.

Our latest project is currently underway at the Creighton Mine located in Sudbury, Ontario.

The project involves field testing of active DPF systems for both Light Duty (< 100 hp) as well as Heavy Duty (>100 hp) Equipment .

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Project Requirements

- Only systems that have received verification or certification such as:
  - VERT
  - CARB
  - EPA
  - MSHA
- Systems cannot introduce any new components into the mine environment
- Systems must be market ready

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Manufactures that have met our requirements for this project:

- Light Duty Test – Mann-Hummel (SMF-AR)
  - Clayton 10 ton Loco – Deutz F6L912W @ 80 hp/60 kW
  - Kubota R520F – Kubota V2203-RP @ 49 hp/36.5 kW
- Heavy Duty Test – HUSS (MK-System)
  - Elphinstone R1700G LHD – Caterpillar 3176E01 @ 310 hp/231 kW

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To initiate and conduct a safe project several steps are required such as the following:

- A scope of work needs to be prepared to identify the various components:
  - Roles & responsibilities
  - Resources
  - Timelines
  - Costs

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The Safe Approach to a Project

Project Name:	Inco Search for Innovative DPF systems/D.E.E.P/Phase 2 A	**Project #:**	
Mine or Plant:	Plant 90	**Area:**	Creighton Mine
Project Owner:	Manger – Mines Technical Services	**Project Start Date:**	June (preliminary stage) 2007
Project Sponsor:	Manager – Mine	**Project End Date: (Phase 2 A)**	September 2009 Phase 2 A
Project Manager:	J.Stachulak	**Project Life (Months):**	+24 Months Phase 2 A
Project Type:	Operating	**Estimated Cost:**	XXXXXXXX

Project Scope Definition

Project Scope Level : **Scoping** **Pre-feasibility** **Feasibility** **Budget**

Project Statement and objectives:

Problem Statement:
There is no finalized DPF device for underground diesel equipment.

Key Objectives:
1. **Evaluated innovative/ DPF systems HUSS/ Germany – for heavy duty vehicles and Mann und Hummel/Germany –for light duty vehicles.**
2. **The aim is to minimize human interaction – 'business as usual" DPF system**

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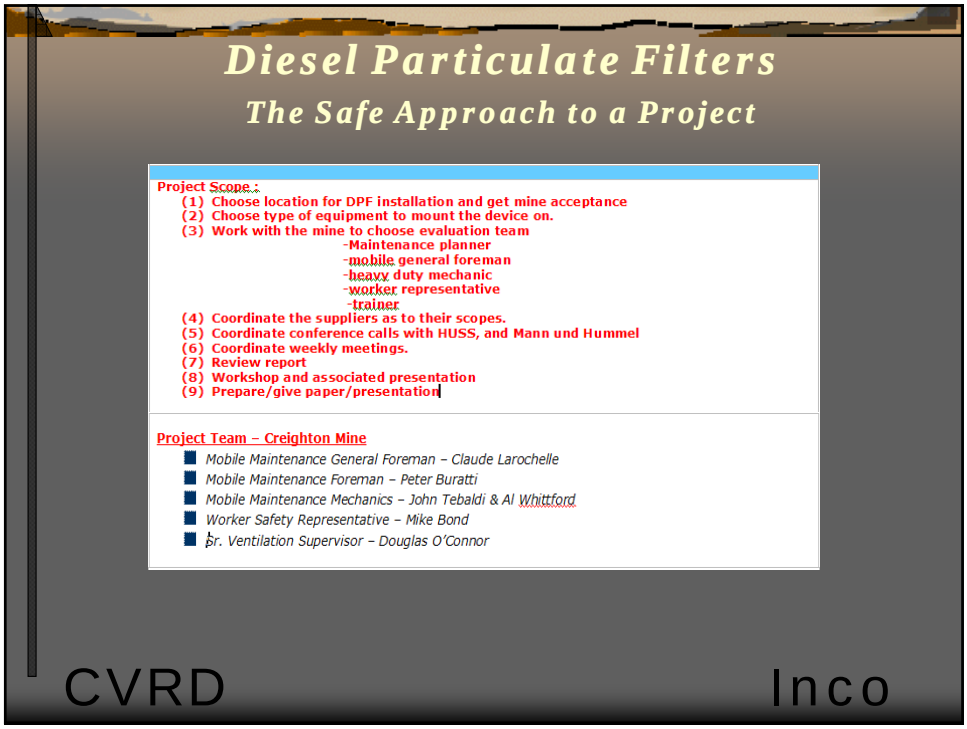
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Project Scope :
(1) Choose location for DPF installation and get mine acceptance
(2) Choose type of equipment to mount the device on.
(3) Work with the mine to choose evaluation team
-Maintenance planner
-mobile general foreman
-heavy duty mechanic
-worker representative
-trainer
(4) Coordinate the suppliers as to their scopes.
(5) Coordinate conference calls with HUSS, and Mann und Hummel
(6) Coordinate weekly meetings.
(7) Review report
(8) Workshop and associated presentation
(9) Prepare/give paper/presentation
Project Team – Creighton Mine
Mobile Maintenance General Foreman – Claude Larochelle
Mobile Maintenance Foreman – Peter Buratti
Mobile Maintenance Mechanics – John Tebaldi & Al Whittford
Worker Safety Representative – Mike Bond
Sr. Ventilation Supervisor – Douglas O'Connor
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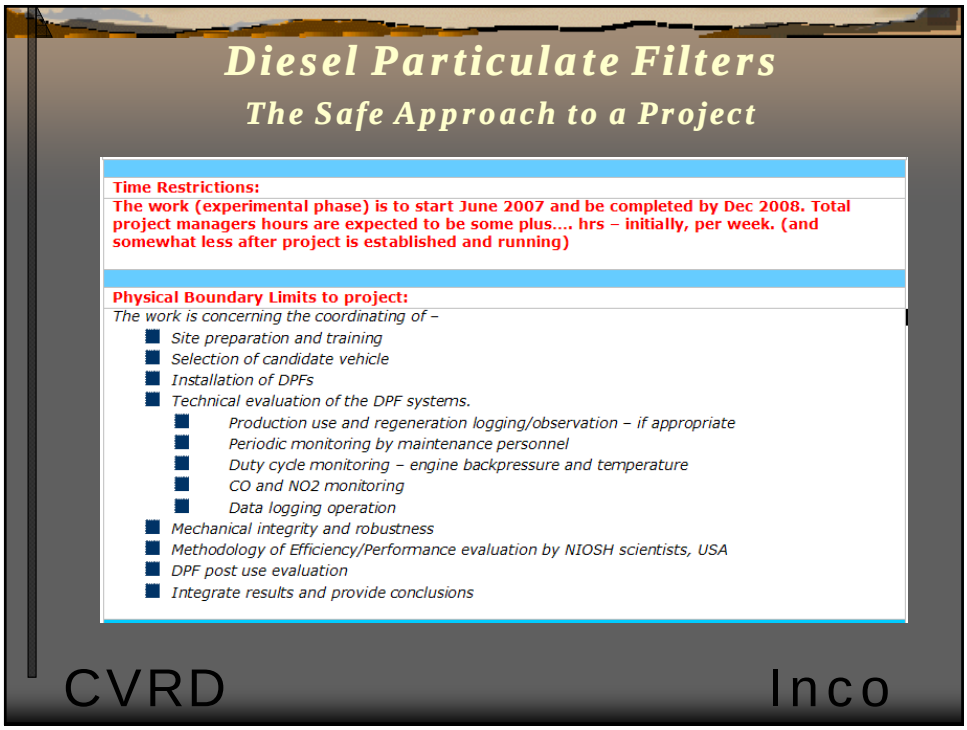
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Time Restrictions:
The work (experimental phase) is to start June 2007 and be completed by Dec 2008. Total project managers hours are expected to be some plus…. hrs – initially, per week. (and somewhat less after project is established and running)
Physical Boundary Limits to project:
The work is concerning the coordinating of –
Site preparation and training
Selection of candidate vehicle
Installation of DPFs
Technical evaluation of the DPF systems.
Production use and regeneration logging/observation – if appropriate
Periodic monitoring by maintenance personnel
Duty cycle monitoring – engine backpressure and temperature
CO and NO2 monitoring
Data logging operation
Mechanical integrity and robustness
Methodology of Efficiency/Performance evaluation by NIOSH scientists, USA
DPF post use evaluation
Integrate results and provide conclusions
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Communications/Reporting plan: (select all that apply)

- ☒ **Kick-off meeting**
- ☐ **SWOT/Scoping workshop**
- ☐ **Charter "Walk-through/sign off" meeting**
- ☒ **Project initiation communication (In-Contact)**
- ☒ **Weekly progress report**
- ☒ **Monthly progress report**
- ☒ **Weekly issues/actions log**
- ☐ **Issues escalation meeting**
- ☒ **Weekly team meeting**
- ☐ **Weekly task/assignment checklist**
- ☐ **Steering team meeting**
- ☐ **Sponsors' meeting**
- ☐ **Video-conferencing**
- ☒ **Audio tele-conferencing**
- ☐ **Net-meeting**
- ☐ **Off-site workshops**
- ☐ **Luncheon/breakfast/dinner meetings**
- ☒ **Project completion communication (In-Contact)**
- ☐ **Project completion celebration**
- ☐ **Other** (describe)

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Special requirements:

Government Regulations

Safety ,Health and Environment:

Specialist Requirement:

- *Interaction with MSHA, CANMET, NIOSH and Universities if required*
- *Other World leading laboratories and Diesel research centers –Switzerland, Germany, Japan, USA.*
- *Detail efficiency measurements, analyses coupled with comprehensive reports*
- *Presentations of findings at MLRC, MDEC, Canadian/USA mining publications*

Risk Assessment:

Management of change and DPF system PHR/Process Hazard Analysis – third party review may be required.

Turn Over Documents/ Deliverables

A final report with recommendations is to be presented to the INCO management team.

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- A Management of Change (MOC) needs to be initiated that will identify the changes that the new components may create:
  - Risk Assessment
  - New Procedures
  - Communications
  - Revised drawings – electrical, system components. Etc.
  - Training for mechanics, operators including manuals

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(Mann-Hummel DPF System, #17-2-119)

Replacement in Kind; Replacement of an instrument, electrical, piping or other component with an identical part

1.	Are the specifications the same?	Yes	No
2.	Is it of the same design?	Yes	No
3.	Are the operating parameters the same?	Yes	No
4.	Is it manufactured by the same company?	Yes	No
5.	Is it the same model?	Yes	No
	• If all answers are YES, then proceed to completion of the job.		
	• If any of the answers are No, check to determine if this is a pre-approved change. (see definitions)		
	• If this is NOT a pre-approved change then proceed to MOC 3		

MOC 3; Management of Change Checklist

1. Is this a change to the existing equipment or facilities (Subtle Change)	Yes	No
2. Is this a change to the process? (Change of Technology)	Yes	No
3. Is there an increase/decrease in energy levels? (I.e.: air, electricity, water, gas etc.)	Yes	No
4. Is there an increase in the exposure to hazards to personnel or equipment?	Yes	No
5. Is any other part of the operation exposed to an increase in hazard?	Yes	No
6. Is there an increased hazard to the environment if the change fails?	Yes	No
7. Could the change result in the process going beyond normal operating limits? Thermal Shock	Yes	No
8. Could the change bypass a safety device or control system?	Yes	No
9. Will the change introduce new chemicals, materials or equipment to the facility?	Yes	No
10. Will the change alter the process/flow configuration?	Yes	No
11. Will the change affect the workplace conditions?	Yes	No
12. Will the change require revisions to procedures, personnel, drawings, changes etc.?	Yes	No
Complete Risk Assessment then proceed to fill out the Management of Change Work Sheet. (MOC 5)		

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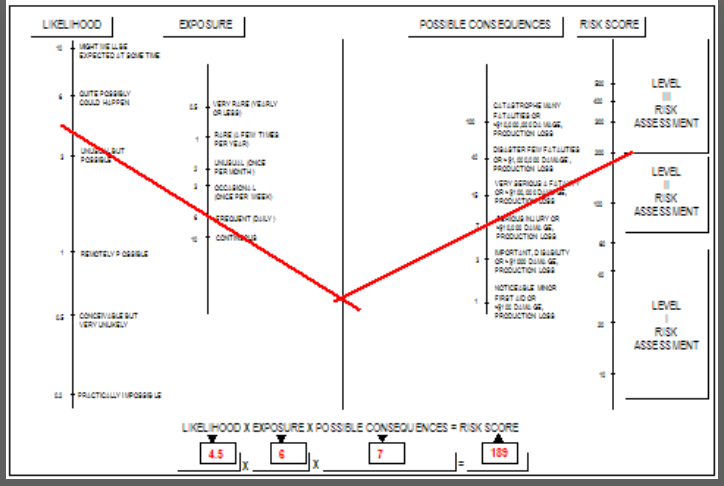
MOC 6; Risk Assessment
Change # 17-2-119



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MOC 5; Management of Change Work Sheet

Plant / Location: Creighton Mine			Date: June 26, 2007
Originator: Douglas F. O'Connor		Change #: 17-2-119	WO #:
Process / Equipment: Mann-Hummel Diesel Particulate Filter System			
Purpose and Description of Change: Remove existing DOC and install a Mann-Hummel DPF active regeneration system			

Risk Score	__<70 _189_<200 __>200	Y / N	Responsibility	Initial Complete
1.	Procedures / Training			
	a)Does the change require a new or revised procedure?	Y	Mann-Hummel/Crtn mobile	
	b)Is additional training required?	Y	Mann-Hummel /CrtnTraining/ Crtn mobile	
	c)Are new or revised training materials required?	Y	Mann-Hummel / CrtnTraining/ Crtn mobile	
2.	Maintenance			
	a)Are revisions to MST.'s required? (PM's & procedures)	Y	Crtn mobile	
	b)Are there any spare parts that must be stocked?	Y	Mann-Hummel /Crtn mobile	
3.	Engineering			
	a)Do drawings need updating? Mann-Hummel system dwgs Crtn mobile electrical dwgs	Y	Mann-Hummel/Crtn mobile (parts manual)	
	b)Is engineering required?	Y	Crtn Engineer	
	c)Is a Pre-Development review required? (MOC 8)	Y	Mann-Hummel/ CrtnTraining/ Crtn mobile/Crtn OSHE	
4.	Safety			
	a)Are there any environmental/health impacts?	N		
	b)Are new M.S.D.S.'s required?	Y	Mann-Hummel/Crtn mobile/MTS	
	c)Is any form of Safety Review required?	Y	Mann-Hummel/Crtn mobile/MTS/Crtn OSHE	

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Plant / Location: Creighton Mine			Date: June 26, 2007	
Originator: Douglas F. O'Connor		Change #: 17-2-119	WO #:	
Process / Equipment: Mann-Hummel Diesel Particulate Filter System				
Purpose and Description of Change:				
Remove existing DOC and install a Mann-Hummel DPF active regeneration system				
Risk Score	__<70 _189_ <200 __>200	Y / N	Responsibility	Initial Complete
d)Is a Process Hazard Analysis required?		Y	Mann-Hummel / CrtnTraining/ Crtn mobile/Crtn Operating/CRT N OSHE/	
5. General				
a)Does anyone need to know of this change?		Y	Mann-Hummel / CrtnTraining/ Crtn mobile/Crtn Operating/CRT N OSHE/Crtn Management	
b)Are any approvals required, internal / external?		Y	Mann-Hummel / CrtnTraining/ Crtn mobile/Crtn Operating/CRT N OSHE/Crtn Management	
c)Is there a quality assurance plan required for this change?		Y	MTS/Crtn mobile/ Mann-Hummel	
6. Other Requirements				
Approval to Proceed with the Change				
Originator	(Print & Initial)	Y	D. O'Connor	
Level 1 Risk Approval	(Print & Initial)	Y	C. Larochelle	
Level 2 / 3 Risk Approval	(Print & Initial)	Y	Mine Manager	
Independent Reviewer	(Print & Initial)	Y	Hatch	
Approval to Start up System	(Print & Initial)	Y	Manager - MTS	

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- A Process Hazard Review (PHR) is conducted to support the management of change. The intent is to review the new system with respect to installation, operation and maintenance for possible hazards the require mitigation. These include such areas as:
  - Fire – serious threat in an underground environment
  - Personal Injury
  - Loss of Control
  - Mechanical Failure
  - Hazardous Materials
  - Logistic Systems

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- Mitigation of identified hazards needs to be addressed to ensure the safe operation and maintenance of the equipment.
- Some types of protection include:
  - Training and follow-up
  - Procedures
  - Initial equipment inspection
  - Proper preventative maintenance & schedules
  - Extra protective devices such as fire proof wrapping, suppression systems
  - Proper Labeling – Warnings, WHMIS
  - Location of system components

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- The PHR process comprises of several components that ensure not only are hazards identified and risks evaluated but also what is currently in place for protection, what addition action is necessary to safeguard the workers but also assigns responsibility to ensure it takes place.
- Once the PHR is completed then the MOC is signed off by management and implementation can now proceed.

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General Hazards Checklist

PLANT: Creighton Mine — EST/JOB NO.:
PROJECT TITLE: Mann-Hummel DPF System
COORDINATOR: Douglas F. O'Connor — DATE: June 25, 2007

INTRODUCTION

Potential Hazards are listed to stimulate "what-if" questions. Additional hazards and combinations of hazards can also be listed. Identified hazards are transferred to the Process Hazards Review minutes for analysis.

☐ No Hazards Identified (No Minutes Attached)

Please check which hazards apply.

FIRE	☒	PERSONAL INJURY	☒	ENVIRONMENTAL IMPACT	☒
EXPLOSION	☒	ELECTROCUTION	☐	HAZARDOUS MATERIALS	☒
SNEAK CIRCUITS	☒	ASPHYXIATION	☐	HOT METAL	☐
TOXICITY	☐	OPEN HOLES	☐	DUST	☐
RADIATION	☐	FALL OF GROUND	☐	WATER	☐
CORROSION	☐	MECHANICAL FAILURE	☒	NOISE	☒
LOSS OF CONTROL	☒	UTILITIES FAILURE	☐	VIBRATION	☐
		LOGIC SYSTEMS	☒	WINTER	☐

ADDITIONAL COMMENTS:

A DPF system is to be installed on a Clayton Locomotive on 5000 level as a pilot project
A DPF system is to be installed on a Kubota R540F forklift service vehicle on 7200 level
MOC # 17-2-119

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CVRD Inco — Form E-303

PROCESS HAZARDS REVIEW

Concept ☐ | Design ☒ | Commissioning ☐
Budget Estimate ☐ | Construction ☐

PLANT:	Creighton Mine	REVIEW TEAM:	C. Larochelle (Crtn Mobil	MEETING:	1
			P. Buratti (Crtn mobile		
PROJECT:	Mann-Hummel DPF Systm		M. Bond (Crtn USWA)	DATE:	June 25, 2007
	Pilot Project: MOC #17-2-119		J. Stachulak (CVRD Inco)		
			M. Reichert Mann-Hummel		
EST./JOB NO.:			D. O'Connor (Crtn Vent.)		
			C. D'Aoust (Crtn Training		

ITEM #	EVENT (What if/Consequences)	HAZARD	MAJOR/MINOR	EXISTING PROTECTION	RECOMMENDATION	ACTION BY/ STATUS
1	Flammable fluids on hot surface (hydraulic, diesel fuel, additive)	Fire	Major	1. Operators initial checks 2. Pre Inspection audit 3. Preventive maintenance 4. Heat Proof wrap (sleeping bag)		None
2	Wiring short circuit	Fire	Major	1. Fire retardant wire & looms used. 2. Operators initial checks 3. Preventive maintenance	Fire retardant wiring & sleeping bag	Mann-Hummel
3	Housekeeping - flammable material (rags, etc.)	Fire	Major	1. Operators initial checks 2. Pre Inspection audit		None
4	Suppression System	Fire	Major	Extinguisher	Investigate the need/requirement for a suppression system	Crtn Mobile & MTS
5	Static Build-up	Explosion	Major	System is grounded		None
6	Electrical System – sets off explosives	Explosion	Major	OHSA & CVRD Inco standards	Review power output with respect to allowable	Crtn Mobile & G. Anderson

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Form E-303

PROCESS HAZARDS REVIEW

ITEM #	EVENT (What if/Consequences)	HAZARD	MAJOR/MINOR	EXISTING PROTECTION	RECOMMENDATION	ACTION BY/ STATUS
15	Warning Lights Burnt Out	Loss of Control	Minor	1. System design, visual, audible alarms & display 2. Data logging 3. Preventive maintenance		None
16	Burns from Hot surfaces	Personal Injury	Major	1. Training for operators & mobile 2. Proper PPE 3. Communication 4. Heat Proof Wraps/Sleeping Bags 5. Preventative maintenance		None
17	Inhalation or Ingestion of Soot & Ash (During filter cleaning)	Personal Injury	Major	1. Training on handling filter 2. Proper PPE (respirator) 3. Good hygiene practices	Filter cleaning cabinet	Mann-Hummel
18	Adding fuel additive	Personal Injury	Major	1. Special containers (1 litre) 2. Proper identification & labels 3. Training & procedures 4. Proper PPE 5. Mobile personnel only	Develop training and procedures	Mann-Hummel, Crtn mobile, Crtn training
19	Pinch points (due to new components)	Personal Injury	Major	1. Proper installation 2. Training & awareness	Train operators and mobile	Mann-Hummel, Crtn mobile, Crtn training
20	Ergonomic design	Personal Injury	Major	1. Proper design location 2. Training & awareness 3. Proper lifting procedures (weight) 4. Body position	Train operators and mobile	Mann-Hummel, Crtn mobile, Crtn training
21	Mounting & Dismounting (due to new components)	Personal Injury	Major	1. Proper design location 2. Training & awareness 3. Proper lifting procedures (weight) 4. Body position	Train operators and mobile	Mann-Hummel, Crtn mobile, Crtn training
22	WHMIS – Fuel Additive	Personal Injury	Major	1. MSDS for product – Dolphin system 2. Proper identification & labels 3. Occ. Health approval 4. Training & awareness	Train operators and mobile	Mann-Hummel, Crtn mobile, Crtn training, MTS, Occ. Health
23	Hot Exhaust Gas temperature – burns (during filter regeneration)	Personal Injury	Major	1. Training & awareness 2. Proper location of exhaust discharge 3. Communications	Train operators and mobile	Mann-Hummel, Crtn mobile, Crtn training

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The Safe Approach to a Project

- Only with a sound approach such as the one taken by CVRD Inco as presented today can diesel emission initiatives be conducted in a Safe & productive manner that will result in the successful completion of the projects.

Thank You

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