Project Name:	Mac & Mac pipe liner removal process (LOSS)	**Start Date:**	2017-11-06
Project Number:	1801	**Completion Date:**	2018-10-06

Project Details:

Scientific or Technological Objectives:

Measurement	Current Performance	Objective	Has results?
Remove 2 layers of liner (1=Yes / 0 =No)	0	1	Yes
Remove only inner liner (1=Yes / 0=No)	0	1	Yes
Avoid pipe damage (mm)	5	2	Yes

This project example is based on the tax court case of MAC & MAC HYDRODEMOLITION SERVICES INC. vs. THE QUEEN Docket: 2017-1942(IT)I (Oct 27, 2017)

Mac & Mac Hydrodemolition Services Inc. tax credits for two different projects. Both projects involved large metal pipes used to transport bitumen. The inside of the pipes was lined with a quarter inch of rubber and that rubber, in turn, was coated by a one-inch polyurethane coating. Over time, the bitumen travelling through the pipes caused wear to the lining, which meant that eventually the pipe had to be replaced.

For the purpsoes of this example we will consider these 2 projects as separate activites in the same project.

Mac & Mac was approached by a potential client to see if Mac & Mac could develop a method of removing the entire lining without damaging the pipe. The first activity was to develop a method of removing the entire lining.

After Mac & Mac succeeded in this goal, the second activity was to develop a method of removing only the polyurethane lining while leaving the rubber lining intact.

Field of Science/Technology:

Mechanical engineering (2.03.01)

Project Details:

Intended Results:	Improve existing processes
Work locations:	Lab
Key Employees:	
Evidence types:	Samples, prototypes, scrap or other artefacts; Records of trial runs

Scientific or Technological Advancement:

Uncertainty #1: Removing entire lining

Mac & Mac tried many different techniques to remove the linings. As Mac & Mac's company name indicates, its speciality is hydrodemolition. Thus, all of the techniques that Mac & Mac employed involved the application of high-pressure water.

It tried hydraulicing, cutting and milling. Hydraulicing involves using a water jet to pierce through the material that you are trying to remove in such a way that large pieces of the material are removed when the water rebounds from the hard surface behind the material.

The most significant underlying key variables are:

nozzle size & distance (unresolved), nozzle speed, spin, rotation (unresolved), water pressures & spray angles (unresolved), length of nozzle arms (unresolved)

Technology or Knowledge Base Level:

Benchmarking methods & sources for citings:

Benchmark Method/Source	Measurement	Explanatory notes

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Internet searches	3 Articles	IDEALLY THE CLAIMANT WOULD ILLUSTRATE THE SOURCES USED TO BENCHMARK EXISTING METHODS.
Patent searches	8 patents	PRIOR ART SEARCH EXAMPLE - HOW TO SKIM PATENTS

Activity #1-1: Hydraulicing to remove entire lining (Fiscal Year 2017)

Methods of experimentation:

Mac & Mac began the first project by trying hydraulicing. The initial approach was to use two nozzles attached to a device that they would drag through the pipe.

Changes that Mac & Mac tried included using different angles of spray, using different water pressures, increasing the number of nozzles, altering the size of the nozzles, adjusting the distance between the nozzles and the linings, making the arms on which the nozzles were mounted rotate, changing the length of the arms, making the nozzle heads themselves spin, altering the speed of the arm rotation, altering the speed of the nozzle spin, adjusting the speed with which the nozzles were moving through the pipe, and adjusting the means by which the apparatus was moved through the pipe. Mac & Mac changed only one of these variables at a time.

Results:

- Remove 2 layers of liner: 1 1=Yes / 0 =No (100% of goal) -- SUCCEEDED IN REMOVING 2 LAYERS
- Avoid pipe damage: 3 mm (66% of goal)

Conclusion:

Uncertainty #2: Removing plastic liner

Cutting involves using a focused water jet to removing very small slices of material one at a time. Milling involves removing one layer of material at a time until, after multiple passes over the material, it is all gone.

The most significant underlying key variables are:

differing simultaneous water pressures (unresolved), pipe rotation speeds & directions (unresolved), number of passes (unresolved)

Technology or Knowledge Base Level:

Activity #2-1: Milling method to remove only plastic lining (Fiscal Year 2017)

Methods of experimentation:

Method	Experimentation Performed
Analysis / simulation:	100 alternatives
Trials:	50 runs / samples
Physical prototypes:	8 samples

Hydraulicing and cutting would not work for the second project so Mac & Mac had to develop a method of milling. This required a different process than that used in the first project.

Changes that Mac & Mac tried included using two different pressures of water at the same time, rotating the pipe itself (both in the same direction as the arms and in the opposite direction), altering the speed of the rotation of the pipe, altering the number of passes that the apparatus made through the pipe, altering the speed of those passes, mounting the apparatus on a long beam instead of wheels, changing nozzle heads between passes, and changing the water pressure between passes. Mac & Mac had to to find a beam construction that was strong enough to withstand the kickback from the water yet light enough to avoid sagging. Again, Mac & Mac changed only one of these variables at a time.

Results:

- Remove only inner liner: 1 1=Yes / 0=No (100% of goal) -- SUCCEEDED IN REMOVING SINGLE LINER.
- Avoid pipe damage: 2 mm (100% of goal) -- ABLE TO ACHIEVE MINIMAL DAMAGE TO PIPE INTERIOR.

THE JUDGE COMMENTED:

[8] Mac & Mac kept a set of handwritten notes. The notes were compiled weekly. The notes describe the various parameters that were being tested in only vague terms. The notes do not contain any hypotheses. There is no way of telling what Mac & Mac hoped to achieve from the changes. The notes also contain scant details about the changes being made. For example, the notes indicate that Mac & Mac tried different nozzle sizes and angles but they do not specify what those sizes or angles were. Finally, the notes contain very little information about the results of the tests. Given the large number of parameters described above, I would have expected the notes to have been much more detailed. There is simply no way that someone, even someone very experienced in the industry, could hope to replicate or confirm Mac & Mac's results from these notes.

[9] A spreadsheet was also entered into evidence. It provided more detail than the notes. However, it was prepared after the fact for the purpose of supporting the SR&ED claim and still did not contain the level of detail I would have expected. I have not given the spreadsheet any weight.

Conclusion:

BASED ON THE EVIDENCE PROVIDED THE JUDGE RULED:

[10] As noted by Justice Bocock in Highweb & Page Group Inc. v. The Queen:

. . .While evidence of the outcome is important, it is critical to technological advancement that the rigours of adherence to the scientific and experimental method be kept on a detailed and concurrent basis with the conduct of the experiments. Since a negative answer to the hypothesis is a more frequent outcome and frequently as helpful in advancing technological knowledge, detailed step-by-step logging, analysis, and measurement is a mandatory requirement, not an optional addendum. It is the roadmap. If one loses the way and failure results, retracing through these accurate records provides one with the deductive process for developing a different direction, speed or mode to create, locate, size, and arrange the "missing piece in the puzzle". . . .

AUTHOR'S NOTE:

UNLIKE OTHER SR&ED CASES THIS CASE DID NOT PROVIDE DETAILS ON THE TECHNICAL BACKGROUNDS OF THE INVESTIGATORS.

WITH MORE DETAILED RECORDS OF THE EXPERIMENTATION THE CASE WOULD LIKELY HAVE SUCCEEDED. FOCUS WILL BE GIVEN TO CONCURRENT VS. AFTER THE FACT EVIDENCE.

Documentation:

- Offline Documents: JUDGE CONCLUDED INADEQUATE DOCUMENTATION