

CPACL NOVA 50E RESEARCH PAPER SUMMARY

The Centaur Project.

Date:	04/1999	Forum:	A.G.A. Operations Conference Cleveland Ohio.
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Location:	Cleveland, Ohio, USA		
Key Topics:	Precision (repeatability), traceability, calibration standards, ultrasonic metering, meter runs, turbine meter.		

The Centaur project began in January of 1999 as a design for a suitable traceable reference for TransCanada Calibrations multimillion dollar high pressure test facility. It's design includes a NOVA 50E flow conditioner, multipath ultrasonic meter, reference turbine meter and meter tubes with a fusion bonded epoxy coating applied to their internals.

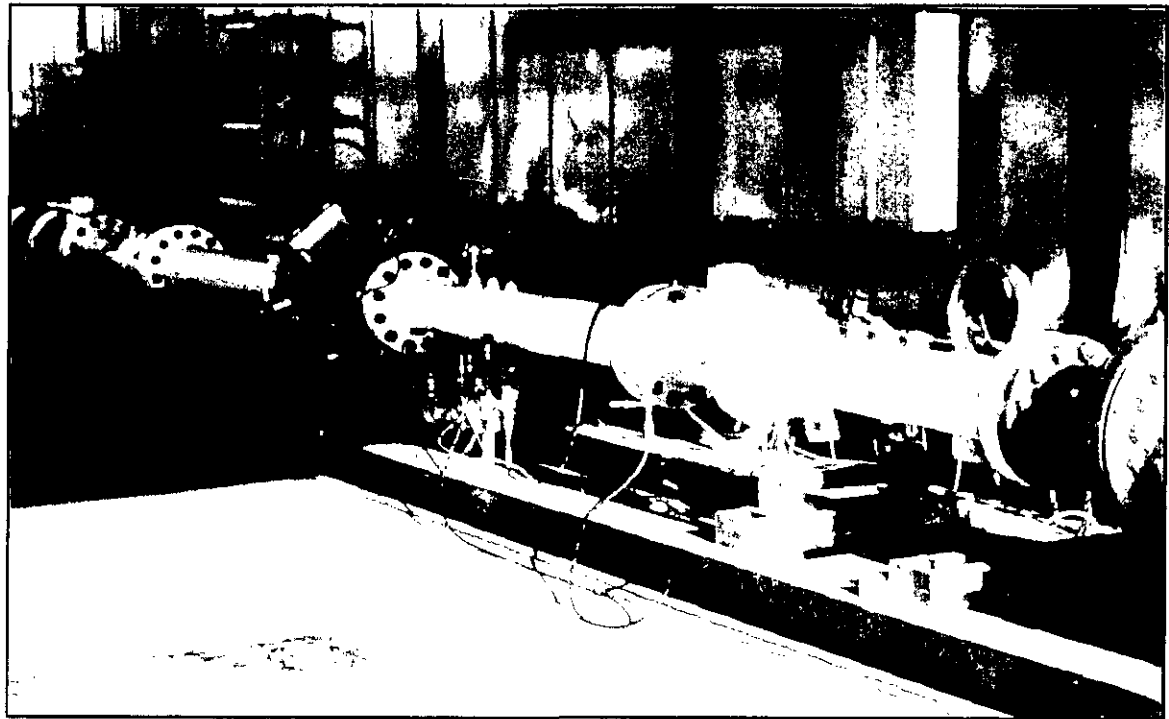
The paper provides results to date of the round robin testing which is being used to provide the accuracy and repeatability of the calibration meter runs. Noteworthy, is the fact that a NOVA 50E flow Conditioner is specified and used for an extremely accurate calibration meter run.

The CENTAUR Project

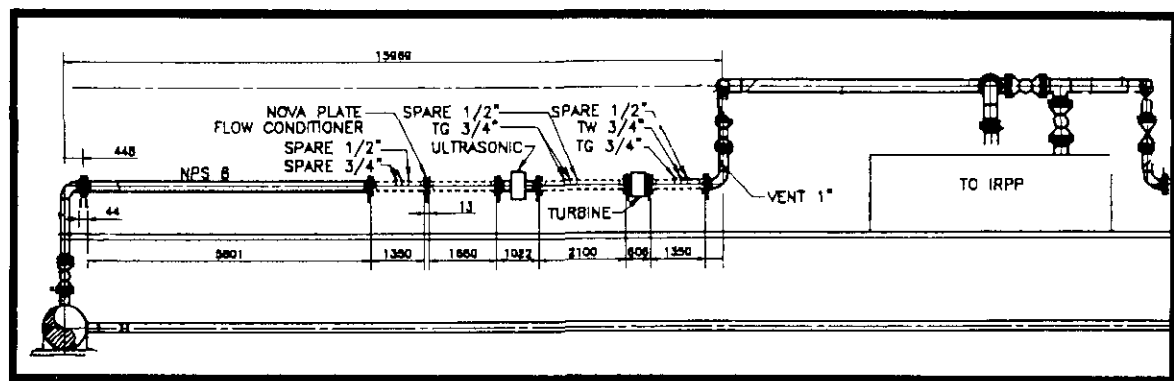
Canadian, European, North American, Turbine And Ultrasonic round Robin

Introduction

The Centaur project began in January of 1999 as a design for a suitable traceable reference for TransCanada Calibrations high pressure test facility. It's design included, a flow conditioner, multipath ultrasonic meter, reference turbine, and meter tubes with a fusion bonded epoxy coating applied to their internals. Basically the design of the reference run incorporates two different types of metering, the ultrasonic and the turbine, both with different behavior, different sensitivity to flow conditions, pressure and temperature effects (this two type approach is also reflected in the name of the project, a centaur being both a horse and a human). Based on the results of testing to date, at five International class test facilities, the Centaur reference run will become a sleeping standard at TransCanada Calibrations, Winnipeg facility.



The Centaur run being tested at Westerbork test station.



Sketch of Centaur installed at the Winnipeg test station.

Background:

To achieve the required capacity and flexibility the design of the Winnipeg test facility, incorporated six NPS 16 and two NPS 8 reference meter runs. The design of each of the reference runs utilizes the two meter type concept. This concept provides for built in redundancy to validate the integrity of the reference. As shown in the above sketch each reference run consist of:

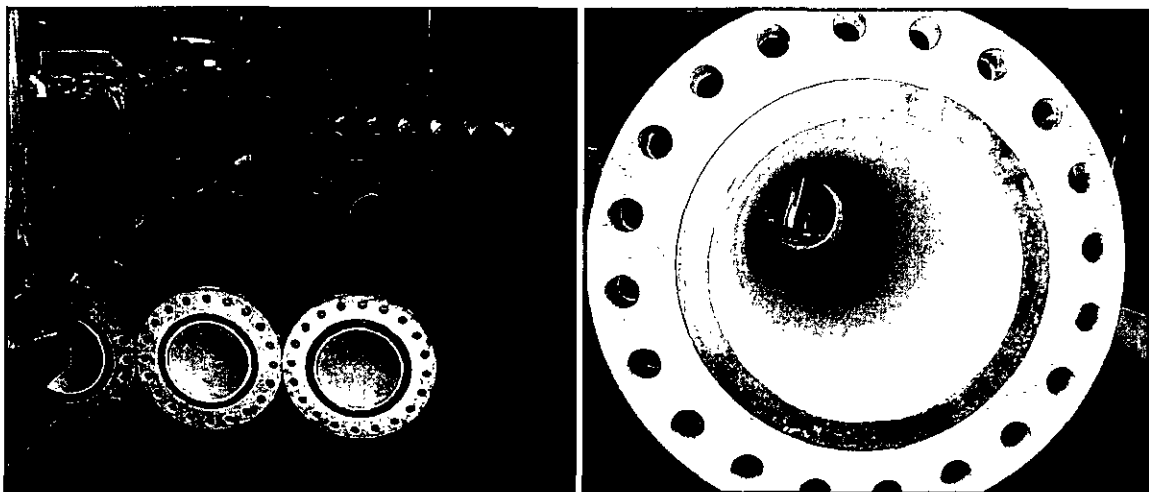
Specification for NPS 8 and NPS 16 reference run design.

Spool piece upstream of flow conditioner	6.5 ID's in length
Flow conditioner	NOVA 50E
Spool piece downstream of the flow conditioner	8 ID's in length
Multipath ultrasonic meter (Nickel plated*)	
Spool downstream of the ultrasonic meter	10.5 ID's in length
Turbine meter	
Downstream of the turbine meter	6 ID's in length

- Ultrasonic meters were nickel plated to guard against corrosion which may impact the dimensional integrity.



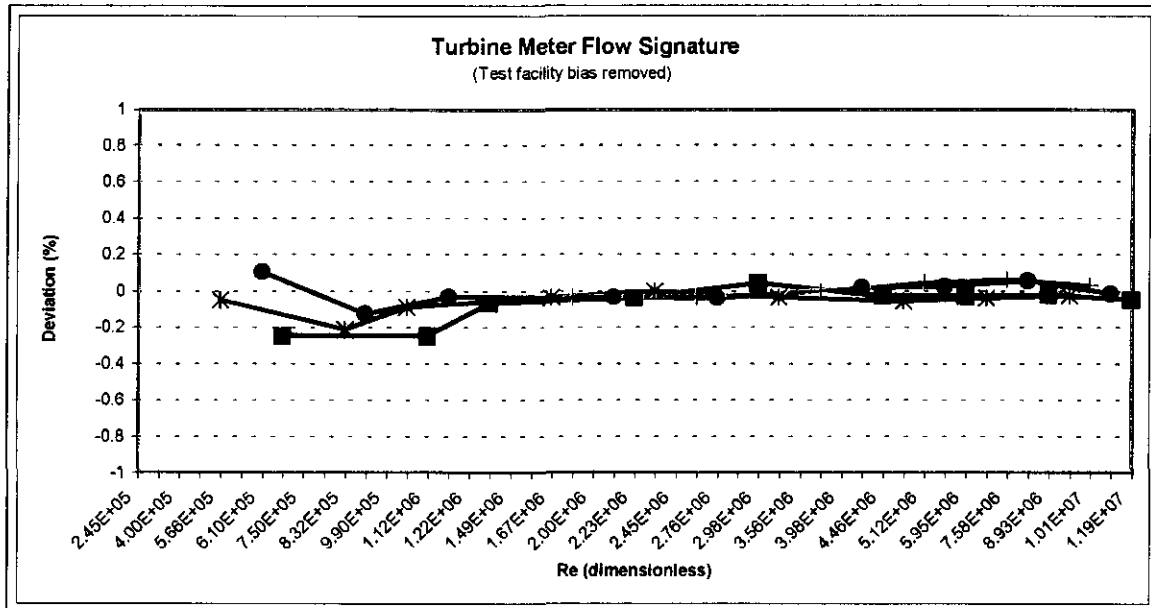
NPS 16 multipath ultrasonic meters - nickel plated.



Reference run tubes with fusion bonded epoxy applied to internal surfaces.

Flow signature from the turbine of the Centaur run, tested four times, at three different facilities.

"Facility bias removed"



Until all the supporting data from the three facilities can be substantiated, the facility bias has been removed from these curves.

This graph clearly indicates excellent repeatability of the turbine, and the reproducibility of test stations participating.

Conclusion:

The Centaur reference run will provide an excellent baseline for benchmarking the results for all ten test stations participating in this project.

A full analysis of all the data is not available at this time since the North American portion of testing has not been completed. Once all the testing is completed a full analysis will be done. At that time the test results will be published and presented to Industry.

Acknowledgements:

Dr. ir. H. Dane
Measurement Consultant
Dordrecht, The Netherlands
Witnessing, gathering, and analysis of test data in Europe

Armin Bergmann
Measurement Consultant
Calgary, Alberta
Analysis and summarization of all test data.

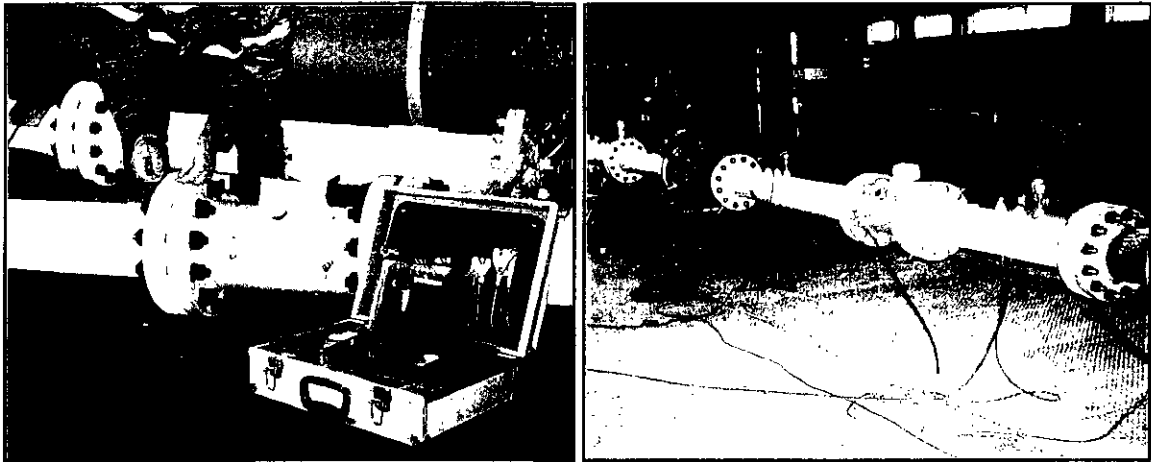
To accommodate both the NPS 16 and NPS 8 reference meter runs it was necessary to design a sleeping standard for each run size.

The NPS 8 sleeping standard (Centaur)

It was decided to establish a correlation between this sleeping standard to be utilized at the Winnipeg test station and currently accredited test facilities in Europe and North America, by a round robin test.

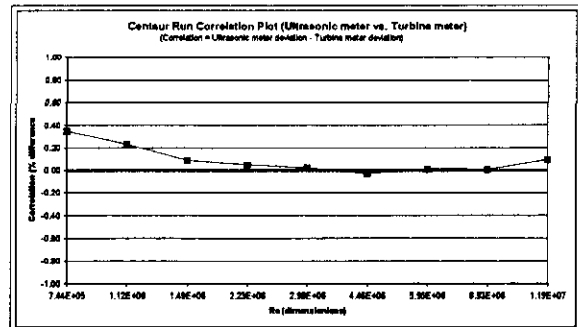
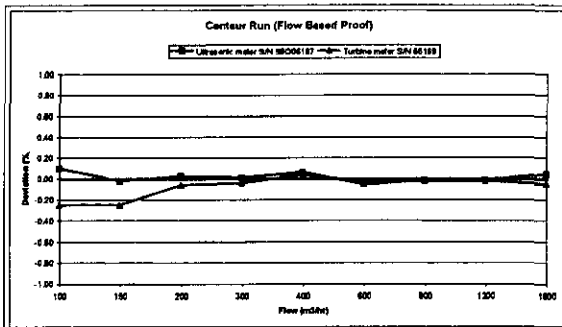
The Centaur reference run started at Westerbork, Netherlands in February of 1999. After finishing the testing at other laboratories in Holland, Germany, and Great Britain, it is now waiting at Westerbork to be tested again to verify it's original performance three months earlier, before being shipped to North America.

At Westerbork the reference run was sealed at all flanges by NMI officials, except the flange between the ultrasonic meter and the upstream inlet spool to the turbine.

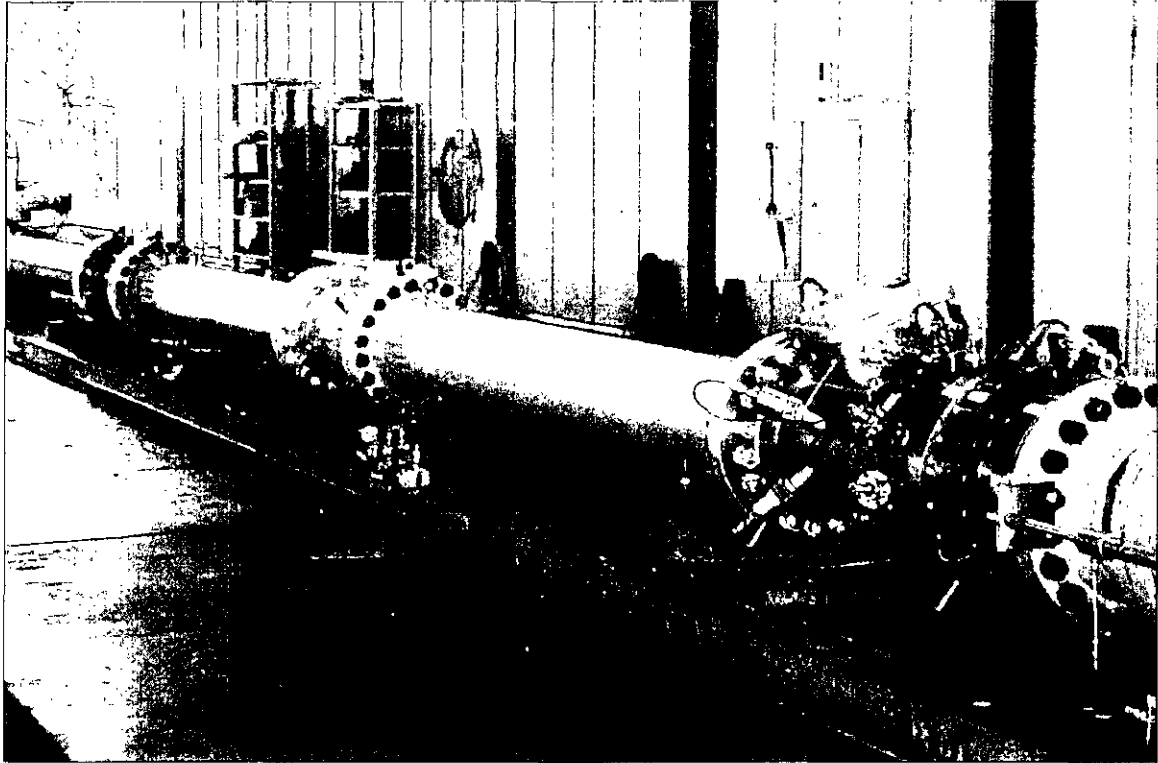


Sealing of flanges at Westerbork before testing began at Groningen.

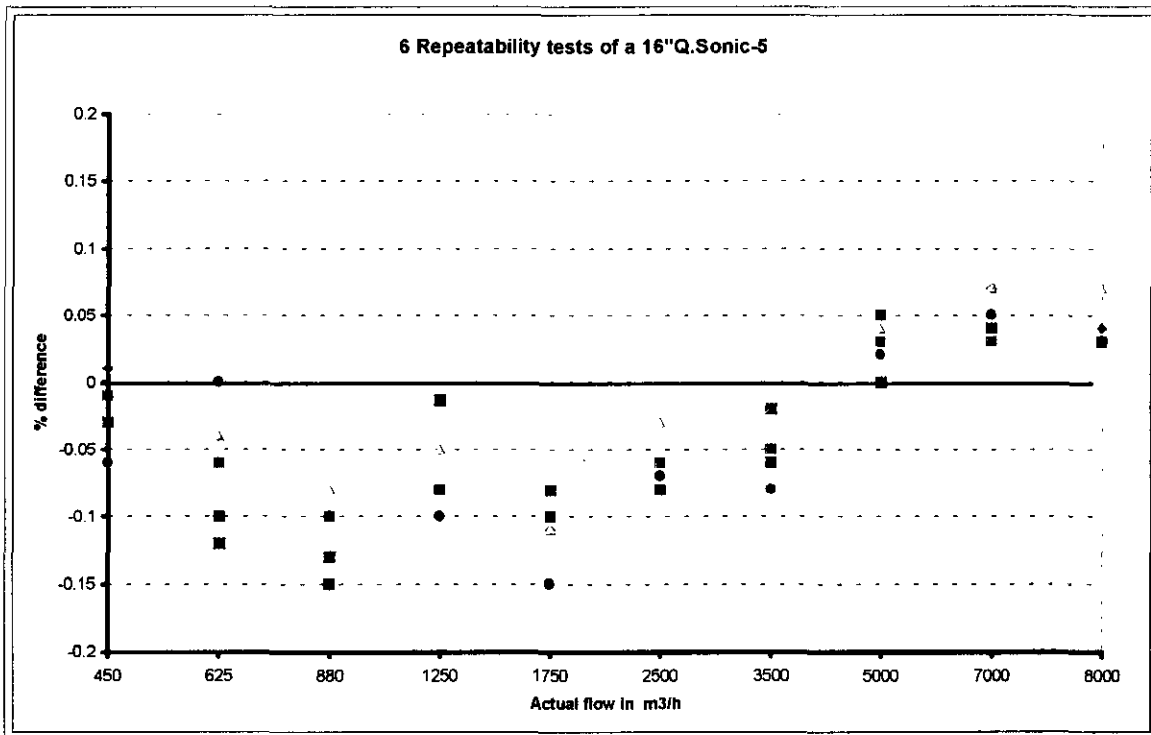
By September of 1999 the Centaur meter run will have included test data from a total of ten high pressure test facilities, of which five will be in North America, one of these being TransCanada Calibrations. The principal aim is to assess the systematic differences among the participating laboratories involved and to reveal possible ways of improving their performance.



Test results from one of the participating labs. First graph red indicating difference of ultrasonic meter and laboratory reference, first graph blue indicating difference of turbine and laboratory reference, second graph green indicating difference of ultrasonic meter minus the difference of turbine meter, referenced to the laboratory reference.



NPS 16 sleeping reference



Test results of one NPS 16 ultrasonic meter