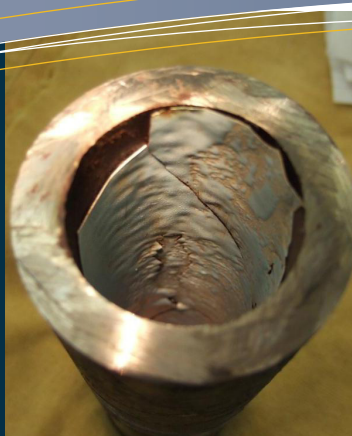




RAE ENGINEERING
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MATERIALS LAB

The materials lab continues reaching for new growth. Additional new test equipment and lab capabilities are on the horizon, and our continued excellent relationship with a local machine shop will assist in these capabilities for expanded testing.

We will be saying "good luck and see you soon" to Mike Durand as he heads back to school in January 2010 to continue his studies in materials engineering at NAIT. Thanks Mike for your work and effort.

The ABCs of Failure Investigation

The RAE Engineering laboratories are often asked to investigate the failure of some or other piece of equipment, infrastructure, or protective lining. Failure investigations can be interesting – they're like playing detective in a technical sense, and are exciting variations on the ordinary.

We recognize that failure investigations are not fun for our clients. Asking RAE Engineering to conduct an investigation generally means something went wrong that is costing the client time and money. In an attempt to make these investigations a less painful experience, we provide the following information on the things we keep in mind when working on failure investigations.

THE VALUE OF THE EVIDENCE

The closer the investigator can get to the source of the failure - in most cases the location, the facility, or the actual item that failed - the better the quality of the evidence gathered.

It's an unfortunate fact of life in Western Canada that most failure investigations are carried out on components or remnants of components delivered to the lab, and the investigator has no opportunity to view these in their original position.

The investigator is forced to rely on second-hand information regarding the sequence of events, the

actual positions of shrapnel (in case of an explosive failure), and the operating conditions at the time of failure.

For the investigator to be able to work within these constraints, it is very important to:

- Obtain as much information relating to the operating conditions at the time of the failure as practically possible;
- Obtain as much information as possible relating to the sequence of events at the time of failure;
- Obtain, if possible, photographic evidence of the failure site, and the relative positions of various components that may (or may not) have been involved in the failure; and
- Have enough data to logically organize the components into their respective level of importance

Starting an investigation before this information is available limits the investigator's insight and objectivity, and can lead him/her onto false trails.

THE VALUE OF OBJECTIVITY

The investigator, especially the experienced investigator, has to guard against falling into the trap of subjectivity. It's easy (and common, unfortunately) for an investigator to make a snap

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COATINGS LAB

The coatings laboratory is pleased to welcome, Christina Bailey, a Co-Op student from the U of A. Christina will be working in many of the different facilities at RAE, but will be spending a large portion of her time in the lab helping us with some new custom testing work for pipeline applications. We look forward to working with her and hope she enjoys the work as much as we do.

The new flexibility tester is now up and running in the Coatings Lab. A few more comparative bend tests are in progress, but the new bender is basically finished and being used for pipe coating test programs. Some of the bender's new features are: ability to handle high-strength high thickness steel samples, additional safety restraints, a triangular mandrel for porosity analysis, and more accurately controlled ram speed.

The autoclave facility was given a major work over and upgrade. In particular, facility's safety was improved with the addition of a number of new pressure relief devices and pressure monitoring points. A final upgrade will occur next month with the replacement of pressure gauges with digital, alarmed pressure measurement devices. The facility simulates sour oil and gas production conditions at temperature and pressures up to 180 C and 1000 psig. It's routinely used to evaluate the performance of coatings, metals, elastomers, and other materials over a range of sour oil field conditions.

(FAILURE INVESTIGATION continued)

judgment regarding the possible cause of a failure, and then consciously or subconsciously work to make the evidence fit the postulate. When this happens, key pointers to the real cause of failure are easily brushed aside, and dubious pieces of the puzzle are forced to fit the picture the investigator wishes to create. Some serious and embarrassing errors have been made when investigators fell into this mode.

It is essential that the investigator initially does an overview of the failure, and identifies the most likely causes of the failure. The Investigation Plan must address how the indicators will be investigated, evaluated, and then either discarded as not plausible or further investigated until confirmed.

THE VALUE OF SYSTEMATIC RESEARCH AND REPORTING

A good Investigation Plan will address, step-by-step, how the work is to progress. A second, deeper examination (e.g. scanning electron microscopy (SEM)) should not be scheduled until the results of the first cut indicates there may be value in performing an SEM examination. Simply doing stuff to bulk out a report is a bad idea.

If there is a logical and systematic investigation underway, and the work leads down a dead end, the investigator can retrace the steps to where the rabbit hole started and then redirect the efforts in a different direction. Without a systematic plan, once a dead end is reached, everyone typically goes into panic mode and a lot of wasted effort results. From a logical and systematic investigation, a logical and systematic report follows. It's very difficult if not impossible to compile a logical, systematic report from jumbled data.

The author of any investigation report needs to realize that the readers of the report fall into two main categories:

THE TECHNICAL READER – THE CLIENT. This will usually be on two levels.

First, there is the immediate client contact. This person is most often technical in orientation – an engineer, technologist, or similar. He/she is most likely the one who will peruse the report in detail, and if he/she understands the subject, may ask for clarification or

even disagree with some conclusions or statements. The report must be clear and detailed enough to satisfy this client.

Secondly, there is the client contact's supervisor or manager. This is in many cases the person who controls the budget – the purse strings. This person is typically of a technical background, but in the position of manager does not have the time to read the report in detail to understand all the details. The report must contain a clear, concise Executive Summary (that's why it's called executive!) the reader pressed for time can read. After reading this, he/she should understand the work done in broad outline and find the conclusion and key recommendations.

THE LEGAL READER – THE CLIENT'S OR OPPOSING FACTION'S LEGAL ADVISOR.

This person is usually not technical in training or disposition. The legal reading of a report concentrates on the semantics. Are there ambiguous statements? Are there (minor) contradictions that can be exploited? Are the conclusions drawn in the report adequately supported by the discussion of the evidence found, or are there conclusions that appear out of thin air?

THE VALUE OF SAFEGUARDING EVIDENCE

In Alberta there is a two-year statute of limitations. Any matter that could be subject to litigation – and all investigation reports must be deemed to fall in this category – can be activated within two years from the date of the report or the incident, depending on the lawyer's interpretation.

That does not mean, by any stretch of imagination, that the case will get to court within the two-year period – merely that the case must be activated. From that point, it can drag for years. A good example is a glycol pump failure investigation done by RAE Inspection (before it became RAE Engineering and Inspection) in 1996. The case had a court date assigned in 2004, and was finally settled out of court in 2007. The pump remnants were removed from storage in November 2009. Clearly, careful control over and protection of the evidence against deterioration are key elements of successfully defending the conclusions of a report after 10 years or so in progress.

ENGINEERING

The last quarter has tested the engineering department's knowledge and skills. We had some new enquiries from India, and so Rajiv Das has been busy running past all the Canadian jurisdictions to register pressure vessels designs from India. Some of these vessels have been designed to code cases that haven't been dealt with before by the jurisdictions. Luckily for RAE we have an expert like Rajiv to get the Indian registrations through this maize on time.

An interesting case we've been working on for the past few months involves a client for whom we do engineering troubleshooting. This client bought some spherical vessels that had to be registered with ABSA in cyclic service with no history available. Searching the REMS (RAE Equipment Management System) database, our engineers found the vessels. They belonged to another RAE client, and Izak Roux had been to British Columbia (B.C.) in 2005 to do a detail inspection. Armed with the fatigue analysis and finite element analysis reports done by Rajiv, Jason Durand and Joseph Yeung, the client, Rajiv and Izak went to see ABSA to present the case of the spheres with great success. These vessels will be registered and the client enrolled in a program monitoring the fatigue life with a follow-up review to be done five years from now. We think this is pretty good proof

President's Message

2009 is coming to a close soon and it's time to look back and also into the future. In 2009 RAE Engineering has strived for excellence in what we do. Whether it was a task for an internal client or a project for an external client, both were important to us. We strived to do our best and to deliver a quality service, excellent in technical quality, that was on time and cost-effective.

This reminds me of the management guru Tom Peters. He published the best-seller *In Search of Excellence* with Robert Waterman, and linked performance and excellence permanently. If 2009 was the year in which RAE Engineering worked hard to achieve excellence, then 2010 should be the year we step it up one notch. Mark Sanborn suggests that step up is to strive for distinction. Each one of us at RAE should ask ourselves the question, "What can I do to make my service to the client distinctive?" We'll aim for that extra little bit our clients will remember.

On behalf of all the personnel at RAE Engineering I would like to thank all our clients, big and small, for giving our company the opportunity to offer its services to you. RAE Engineering strives to deliver total asset integrity engineering and inspection services to the industry. Be it with cold at our backs or a deadline over our heads, we are always keen to take on new challenges.

The warmest welcome to our newest employees: Trevor Davies, senior engineer in Calgary; Evelyn Black, our new HR Manager; Rose Balog in Accounting; and Pieter Visagie as junior engineer. I hope you will enjoy your work at RAE Engineering, always reaching for excellence and enjoying what you do. You will find support from your fellow peers whenever you need it.

December is the festival season and on behalf of the directors and management team, I wish all personnel and clients a Merry Christmas and a prosperous New Year. For those who will have a break and time off, enjoy the quality time with your family. We look forward to welcoming you all back in 2010.

Izak Roux, M.Eng. P. Eng
President and Technical Manager



(FAILURE INVESTIGATION continued)

Finally – the important factors in any successful failure investigation are:

- Systematic and objective investigation
- Systematic and logical reporting
- Careful safekeeping of evidence
- Careful and good record-keeping

Good luck with your failure investigation. We hope this information will help you know what to look for in a good investigation.

that RAE can provide the needed support even in complicated cases.

RAE Engineering is a registered inspection company, so in the last quarter a small team has been preparing for the ABSA audit. Trevor Paananen and Debra Corns are making sure that our systems are technically sound and in place. On the documentation management side, Kimberly Stewart and Kristin Buhl have been auditing all the engineering reports created since 2007, and then transferring them to a new electronic backup and documentation control database.

In the materials lab the failures are keeping Perry Richard and Mike Durand on the move. If it's not a small pipeline failure then it's a pump-jack with a mysterious bolt failure. In between all the other work, Eric Peng scrambled with Izak to northern B.C. to investigate a compressor fire. Negotiating 12% gradients to get to the site makes the journey a mission on its own. But these journeys into the hinterland make working with RAE lots of fun - aside from the technical challenge, we're also able to provide excellent service to our clients.

Proper Pressure Equipment Insulation



Winter has arrived, and with it brings some insulation considerations for RAE Engineering's clients. We asked senior inspector Bala Vanumamalai to share some of his experience about proper insulation. According to Bala, failure of insulated systems is uncommon with the proper insulation in place. But if the component is uninsulated and exposed to very low temperatures, it will happen frequently.



He recalls that last winter, in an oil sand facility, around 10 pieces of pressure equipment (all exchangers) were found with bulged heads and/or broken tubes. And more than 15 piping systems were found split and with brittle fractures more than a foot in length. All the equipment and piping systems were insulated and some of them were heat traced too. However, nothing was insulated properly.

The plant was very new, and all the exchangers were installed in 2007/2008. All of them were insulated with final cladding on the shell side. Unfortunately none of the exchangers' heads were cov-

ered by either insulation or weather resistant blankets. So, when the temperature dipped to -36 C, the cold transferred through the heads and ice formed at the nozzles, causing the exchangers to bulge and tubes to break since there was no fluid circulation.

The piping systems were also newly erected in 2007/2008. All of them were insulated with cladding and some were fully heat traced. Still, around 15 piping systems were split and broken like glass due to cold related brittle fracture. All the fracture locations were thoroughly inspected. Inspectors observed a similarity in all failures: they happened very close to the pipe shoes/saddle supports. These had never been protected by either insulation or weather resistance resistant blankets. As a result, the cold transferred through the pipe shoes/saddle supports and fluid or steam became ice blockages, which split or fractured the piping system.

This example illustrates the importance of making sure all the pressure equipment in a facility, especially equipment in the open field, is properly insulated or covered by weather resistance resistant blankets before the temperature drops to the double-digit negatives.

TIP

What happens if a failure does occur on live equipment due to inadequate insulation, and the equipment is unsafe for operation?

Once the immediate danger has been resolved, the facility's chief inspector needs to complete [ABSA form AB-139](#) (Unsafe Condition Reporting). The failure must then be dealt with appropriately.

Bala cautions area operators responsible for day to day surveillance of their facilities to make sure all the necessary precautions have been taken. After all, it's inevitable that there will be a few really cold days this winter. Remember, keep pressure equipment protected properly and be safe all the time.



NEWSLETTER FEEDBACK

Send your questions, comments and ideas to news@raeengineering.ca

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Staff Training Session

RAE Engineering is committed to ongoing training for all staff. Twice a year, the company sponsors a two-day training session. These sessions are held off-site at the Woodvale Community Facility at Edmonton's Mill Woods Golf Club.

Our next session takes place the 7-8 December. Senior management will make presentations followed by our monthly safety meeting. We also have some guest speakers. They include:

- Pipetech, who will do a session on pigging (if you wonder what that is, click [here](#) to check out the Wikipedia explanation;
- McBain Camera, who will talk to us about digital camera use; and
- Metalogic Inspection Services, who will be presenting on phased array NDE.

We're also pleased to welcome back our president emeritus, Hennie Prinsloo, who will be presenting seminars on safety codes and corrosion.

RAE Engineering's training sessions are focused on providing staff with up to date industry information and new trends. However, it also lets staff who are frequently out of the office (executing inspection and other integrity work) catch up with co-workers and progress on other RAE projects. Our work is not complete until the proceedings of the session are collated and made available in hard copy in the RAE library. As with everything we do, it's a team effort from start to finish.

If you are interested in presenting at RAE Engineering's next staff seminar, please contact Debra Corns debra.corns@raeengineering.ca.

Laricina Energy Integrity from the Beginning

RAE Engineering has a new client presenting us with an exciting opportunity to help manage integrity throughout a project's entire life cycle. Laricina Energy is a company formed to exploit heavy oil deposits west of Fort McMurray. Izak Roux met with Laricina several times as the company and its project matured, and that work is paying off. RAE is now participating early to help ensure the integrity in the design and construction of a 5000 bpd pilot SAGD plant.

Since late November, RAE's Aleksander Pokerznic has been doing third party inspection work at a fabrication shop in Ponoka, overseeing piping module construction. Laricina will start site work this winter with production starting in the fall. RAE will be there throughout this project and Trevor Davies, P.Eng will act as our project manager. Early in 2010 Trevor will start with the groundwork for a Total Integrity Program. The objective is to have ABSA approval before start-up. If the pilot plant works as designed, Laricina has big plans for a 500,000 bpd plant to be built in 2012.



Working closely with Laricina is something we're enjoying very much. We're pleased that this project represents an exciting opportunity for RAE Engineering to show how we successfully manage the integrity of large projects from the very beginning.