Jeff Foote, Director of Pipeline Integrity Technology, T.D. Williamson, USA, considers how upcoming PHMSA regulations will require operators to perform comprehensive pipeline provenance projects.
Do you have your grandfather’s stubborn streak, or your great-aunt Irena’s love of music? Perhaps your cousin twice removed was a math whiz in New Delhi, who passed his dark eyes and numbers sense onto you.

Most people are eager to trace the origins of their traits and find out where their personality, preferences or appearance came from.

And some individuals are lucky — they have access to genealogies handed down through the ages that help them understand the family influences that have shaped who they are today.

For others, it takes a little more digging to uncover their personal history, perhaps a few dozen hours on an historical records website or a cheek swab sent off to a DNA testing service.

But understanding what you are made of and where you come from is not just for people. Pipelines have provenance, too. And just like an unknown ancestor, the complete back story of a pipeline section — information about material grade and chemical composition, for example — is not always available, either.

Maybe the records were never kept in the first place. Or they were lost through time, or when assets were transferred or sold. Or the records exist, but the information is incorrect.

Soon, however, the days of missing and incomplete materials records for gas transmission pipeline operators in the US will be over, with hazardous liquids operators following shortly.
That is because the Pipeline Hazardous Materials Safety Administration (PHMSA) has regulation pending that will require operators to verify the records they use to establish and support the maximum allowable operating pressure (MAOP) of pipelines in high and moderate consequence areas. In addition, PHMSA has announced its intention to eliminate a grandfather clause that has allowed gas transmission operators to rely on historical data for establishing the MAOP of pipe installed before 1970.

As a result, operators will have to perform what is essentially a comprehensive pipeline genealogy project in order to meet the upcoming regulations. Included will be validating and documenting the mechanical properties – such as construction materials by grade and specification, yield strength and tensile strength – of all pipelines located in high and moderate consequence areas, regardless of when they were built.

But how will they find out what they do not already know? Unlike curious family members, pipeline operators cannot just search the industrial equivalent of a genealogical database. To get to the information they need, there is an alternative as unobtrusive as a DNA cheek swab: non-destructive positive materials identification (PMI) technology used as part of a complete integrity verification process (IVP).

A call for ‘traceable, verifiable, and complete’ records

Like any number of governmental regulations that arose from a public safety concern, PHMSA’s pending rules were motivated by an accident, and a catastrophic one at that: a deadly explosion and fire caused by the rupture of a gas pipeline in the state of California.

In the US, the National Transportation Safety Board (NTSB) is among the first on the scene to investigate the cause of significant pipeline incidents as well as aviation, railroad, highway and marine disasters. During the course of their inquiry into the California pipeline failure, the NTSB found that a ruptured section of pipe had been identified on the as-built drawings as seamless when it was actually longitudinally seam-welded, which meant the pipeline was being operated outside of its original design criteria. The NTSB subsequently recommended that operators establish pipeline records if none existed in order to verify that operating conditions are within the specifications of the line configuration – a recommendation that PHMSA is upgrading to a regulation.

In its advisory bulletin (ADB-2012-06) regarding the pending regulation, PHMSA states that operators “must assure that the records are reliable” when calculating MAOP and that “these records shall be traceable, verifiable, and complete.” PHMSA defines verifiable records as those “in which information is confirmed by complementary, but separate, documentation.” The agency also said that operators may need to conduct other activities such as in-situ examination, measuring yield strength, and non-destructive evaluation (NDE) or otherwise verify the characteristics of the pipeline to support a MAOP or maximum operating pressure (MOP) determination.

“Traceable, verifiable and accurate recordkeeping in the pipeline world is crucial,” PHMSA Administrator Cynthia Quarterman said when she announced the pipeline verification advisory in 2012. “It enables us to respond more quickly in the event of an emergency, as well as gives us a more accurate snapshot of the overall infrastructure.”

Early adopters prepare ahead of the proposal becoming a mandate

Response to the advisory has, naturally, been mixed. Some operators and organisations have jumped immediately onto the bandwagon, determined to have their records in place before the proposed regulation becomes a mandate in 2015. Others remain in wait-and-see mode.

The Interstate Natural Gas Association of America (INGAA), a nonprofit trade association whose members represent about two-thirds of the natural gas transmission pipelines in the US, is encouraging early adoption.

In a statement, INGAA said that its members “committed to a systematic validation of records and maximum allowable operating pressure for their pipelines in highly populated areas that predate federal regulations. INGAA members are developing a process to demonstrate traceable, verifiable and complete records with examples of the types of records.”

But beyond the essential importance of complying with regulations, there is additional value to understanding pipeline properties.

For example, in a response to PHMSA’s 2011 Pipeline Safety Report to America, metallurgist Kenneth Kraska says that
developing necessary pipeline documentation keeps operators in compliance with American National Standard Institute (ANSI) codes. Documentation is necessary not only for records review, but whenever welding is performed, replacement pipe materials are obtained, or a pipeline is being reviewed for re-rating. Kraska explains. Welding on a pipeline without thorough knowledge of the materials involved, the correct welding procedure, or the composition of welding filler metal is also an ANSI violation, he adds.

But there is also a positive financial case to be made in support of the regulation, and it goes like this: operators who have had to downgrade pipeline pressure for lack of the records that would justify higher pressure are losing money. By performing PMI, they may find out that their pipelines can actually accommodate higher pressure and, therefore, increased capacity.

And while the PHMSA ruling only applies in the US, similar benefits could accrue for Middle Eastern and Russian natural gas transmission and the Canadian oilsands. In addition, verifying higher operating pressures is considered essential for the safe operation of pipeline reversals and conversions, two activities that are now occurring worldwide.

NDE techniques can save time and money
In engineering, project management and other disciplines, the triangle is used to represent the interdependent nature of certain attributes, like time, cost and scope. The triangle is also useful when it comes to considering positive material identification.

In PMI, one side of the triangle represents material strength, another is the load or pressure, and the last side symbolises defects. In order to keep the triangle from collapsing, all three have to relate to one another appropriately.

For example, strength is determined by the ability to withstand pressure. Defects can alter both strength and load. And pressures above system limits can cause defects to grow. However, a lack of knowledge about any side can upset the overall equilibrium. With appropriate information, operators can keep their triangle in balance.

For generations, operators have had to rely on destructive techniques to identify pipeline materials and MAOP, utilising a time-consuming, costly procedure that involved cutting out a coupon and sending the piece away to be lab-tested. But not any longer. That is because the positive material identification process offered by global pipeline integrity services provider TD. Williamson (TDW) utilises multiple non-destructive technologies that eliminate the need for cutting into the pipeline and can be completed while product continues to flow. TDW’s patent-pending PMI can provide a high level of accuracy with less effort, lower total cost and shorter turnaround.

And beyond that, says Chuck Harris, Commercialisation Manager for Pipeline Integrity Technology at TDW, the predictive nature of TDW’s PMI techniques mean they can reduce the potential for costly field failures when part of a comprehensive integrity verification programme.

Preliminary results are nearly instant
TDW’s PMI solution includes multiple NDE methods (see The A-B-Cs of PMI sidebar).

The process begins by establishing an area to inspect, followed by determination of yield and tensile values, plus chemical composition and carbon equivalence. The results are then compared to American Petroleum Institute specification API 5L, tables 4 and 6, to ascertain the pipe material grade.

According to Chris Caraway, NDE Operations Manager, TDW’s process, performed completely in the ditch in about four hours, means there is “zero destruction to the pipe and product in the line is never affected. The NDE PMI process leaves no potential leak path.”

Reporting time is also much shorter than other PMI methods. Initial findings are almost instantaneous. The operator often has a draft in-hand before the technicians leave the field. Normal turnaround for the complete report is five days. Which is less time than it takes to get a cheek swab result back from the DNA lab.

PMI: determining the DNA of pipelines
While tracking down relatives and adding leaves to the family tree can be fun, there is a serious side to it, too. Like when that cheek swab identifies potentially lifesaving information about the genes you share with your ancestors.

And in that way, PMI is very much like DNA testing for pipelines: it is a way to dig deeper than old records and photographs allow, providing information at the cellular level, mitigating risk today and in the future, while maintaining compliance with industry regulations.

References
1. Visit phmsa.dot.gov for a criteria-based definition of high and moderate consequence areas.