PIPELINE SAFETY WHITE PAPER · COHERENCE

Coherence

Conformance is whether each document is right. Coherence is whether they are right together. | Kevin Graham, Founder

A note on this paper

Disclosure. Systemic Compliance sells the thing this paper argues for. You should know that going in, not find it out at the end. Everything the argument rests on is cited in full, so you can check any of it without taking our word for anything. Where we use our own work as a source, in Sections 5.5 and 9, we say so.

Sources. Every regulatory citation here was pulled from eCFR or the Cornell LII mirror. Appendix B lists them and says how far each one was checked. The data files behind the numbers, and how the trends were tested, are reported in *Pipeline Safety Performance and Regulatory Expansion*, the second paper in this series.

Data. The headline safety series this paper relies on, in Section 2.2, is carried forward from *Pipeline Safety Performance and Regulatory Expansion*, the second paper in this series, which computes it from PHMSA's incident and accident report files (Forms F7100.2, F7100.1, and F7000.1) for January 2010 through mid-2026 and reports the fitted trends and their test results. The state-layer analysis this paper points to, the overlay of what each state adds above the federal floor and how it relates to outcomes, is computed and reported in that same paper. The figures computed and presented here are the state infrastructure and jurisdiction figures in Section 5.5, drawn from PHMSA's 2025 annual report data, and anyone holding the same published files can recompute them. Two figures here are other people's numbers rather than ours, and are labelled where they appear: PHMSA's statement that state programs oversee over 85 percent of the infrastructure under its authority, and the pipeline safety management system adoption figures recited in the March 2025 advisory bulletin.

This series. Three papers, one argument in three steps. *The System You Already Have* asks why an operator would build a pipeline safety management system while it is still voluntary, and shows how much of one the required programs already build. *Pipeline Safety Performance and Regulatory Expansion* reads the public safety record since 2010 and asks what the growing rulebook moved and what it did not. *Coherence* takes the part that did not move and locates it in the connections between an operator's own documents. Any one of them stands alone. In that order, each sets up the next.

Companion work. *The Compliance Paradox* (WRGC Scottsdale, August 2026) describes the mechanism this paper measures.

Standing. Nothing here is a compliance determination. Both parts moved during the period this paper covers. Part 192 has changed many times since 2021, the D.C. Circuit struck down parts of a 2022 rule in August 2024, and corrections followed in January 2025. Part 195 was expanded by the 2019 Hazardous Liquid final rule, which added reporting, leak detection, periodic assessments and inspections beyond high consequence areas. Since then the standards incorporated into Part 195 have been updated twice, by the periodic standards rule effective June 2024 and by a second one effective January 2026, and PHMSA has an open rulemaking on repair criteria that reaches 195.401 and 195.452(h)(4). If you are going to act on a citation in this paper, gas or liquid, read the current text of it first.

1 Executive summary

Before anything else, the record of the last decade deserves stating plainly.

Reported incidents across gas transmission, gas distribution and hazardous liquid fell by about a third from their 2015 peak. Reported injuries fell by more than half. Those gains were paid for and delivered by operators, and regulators drove a good deal of them. This paper is about one number that did not move, and it takes none of that back.

Federal pipeline safety regulation requires each operator to produce roughly ten written programs, plans, and manuals. Every one of them is required to be written. Every one of them is inspected. Nearly every one of them is enforced on its own terms, against its own subpart, by an inspector working a protocol scoped to that subpart.

Almost nothing in that structure asks whether the ten documents describe one system.

You can have a garage full of car parts and still not have a car. Section 3 takes that apart properly. It is worth having in hand from the first page, because it is the whole argument in one line.

They do not describe one system at most operators. They describe ten adjacent systems that share a pipeline. The corrosion program has a repair threshold. The Integrity Management Program has a different one. The O&M manual has a third, inherited from a template. Each one, read alone, is defensible. Read together, they are three answers to the same question, and the field crew at the bell hole picks one.

This paper argues three things.

First, the connections between the documents are not a management theory. They are in the regulation already. Section 192.605(b)(2) requires the Operations and Maintenance Manual to include corrosion control procedures drawn from Subpart I. Section 192.605(b)(12) requires it to include the control room management procedures required by 192.631. Section 192.605(e) requires the continuing surveillance, emergency plan, and failure investigation procedures to be inside the manual. Section 192.1007(b) names corrosion control records, continuing surveillance records, patrolling records, maintenance history, and excavation damage experience as the data an operator must consider when identifying distribution threats. For onshore gas transmission, Section 192.13(d) requires a management of change process that communicates change to affected parties. Section 192.13(c) requires operators to maintain, modify, and follow the plans, procedures, and programs they are required to establish.

The same structure sits in Part 195. Section 195.402 requires the manual and prescribes what belongs in it, and 195.452 requires the integrity program that feeds it. Section 5.2 maps each of the ten documents to its liquid counterpart. Both parts also require change to be managed inside the qualification program, the integrity program and the control room. One difference matters, and Section 8 returns to it: Part 192 adds a single management of change process for onshore gas transmission, under 192.13(d), and Part 195 has no equivalent.

Either way, the regulation assumes an assembled system. It does not require anyone to draw the assembly.

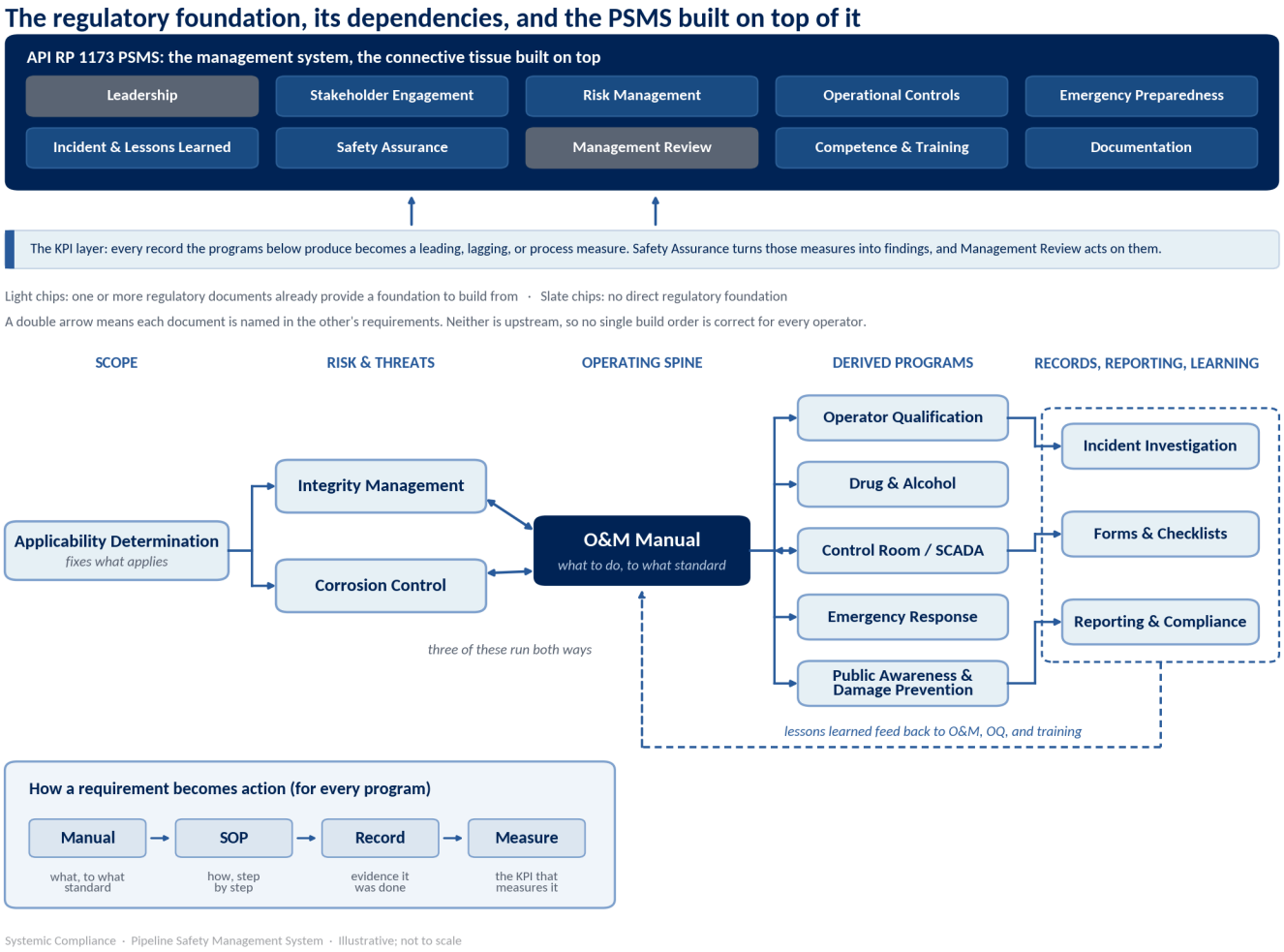

Figure 1. The regulatory foundation, its dependencies, and the management system built on top of it. Every arrow is a connection the regulation already makes between two required documents. Three of them run both ways, which is why no single build order is correct for every operator. The two slate boxes in the top band are the API RP 1173 elements that no required document establishes; the measures derived from the records below them are what those two elements run on. Illustrative; not to scale.

Second, the thing that is missing has a name, and it can be pinned down. We call it coherence. A document set has it when (1) each fact drawn from a requirement is stated in one place, (2) every activity traces back to a requirement and forward to a record, (3) a change reaches everything it touches inside a known amount of time, (4) no two documents give different answers to the same question, (5) nothing is produced that nobody uses, and (6) you can tell where you stand on all of it without reading every page. Section 4 defines each of those so it can be tested. Section 8 lists the eight ways they fail, each with the rule it hangs on.

Third, coherence is where the remaining gain is, and another requirement will not produce it. Add a rule and you add one more part. But you also add a connection between that part and every part already there, so the connections grow much faster than the parts do. Regulation has been very good at specifying parts. It has never specified a connection. That is a plausible explanation for a safety record that improved substantially and then flattened, and it is testable. Section 9 states the model and Section 12 states honestly what it does and does not prove.

For operators this is a money argument as well as a safety argument. When the documents agree, you write a thing once, change it once, train to it once, and answer for it once. When they do not, you do all of that several times over and still have gaps. The rework is what it costs you. The changes that never reach the people who need them are what puts you at risk.

For regulators, the argument is that coherence is enforceable today, under existing authority, with no new rulemaking. Sections 192.13(c) and 192.605(a) already require operators to follow their own programs, and 195.401(a) and 195.402(a) do the same on the liquid side. Two of an operator's own documents that contradict each other on the same act make that impossible to satisfy. An inspection that follows one thread across the whole document set will find more real risk in a day than a subpart-by-subpart document review finds in a week.

2 Where we are

2.1 The five symptoms, and what they have in common

Start with something an operator can check against their own company. Five patterns turn up almost everywhere, and they are usually treated as five separate problems to be patched one at a time. They are better read as symptoms of one condition.

- **Fragmentation.** Compliance scattered across departments, spreadsheets, and tools that do not talk to each other.
- **Variability.** The same covered task performed differently by each crew, contractor, and region.
- **Silos.** Programs running in isolation, so a change in engineering never reaches operations, training, or contractors.
- **Documentation versus reality.** Immaculate records concealing a program that has quietly drifted from how the work is done.
- **Regulatory drift.** Rules, standards, and interpretations moving while procedures and training fall behind, unnoticed.

Four structural causes sit underneath them: performance-based rules that require operator-specific design and therefore write variability into the code on purpose; overlapping federal, state, and OSHA layers with no single owner; change that outruns the programs meant to absorb it; and tools bought one problem at a time and never connected.

Read together, the five describe one condition: *a fragmented system in which a change made in one place does not propagate to the others.* An operator can document everything, pass every audit, and still drift toward risk, because an audit certifies a moment that has already passed.

This paper takes that diagnosis at its word and asks the next question. If the disease is failed propagation, then propagation across what? The answer is the required document set, and the property that makes propagation possible has a name, a specification, and a regulatory basis. That property is what this paper calls coherence.

2.2 What the record already shows

Pipeline Safety Performance and Regulatory Expansion, the second paper in this series, settled this with figures computed from PHMSA's own files, and its finding has a specific shape this paper depends on. The ordinary measures improved and the improvement is real: reported incidents fell about a third from their 2015 peak and injuries fell by more than half, a decline that holds up under testing and belongs to the credit of operators and regulators alike. The most serious outcome did not. Fatalities stepped down in the early 2010s and then held flat across 2015 to 2025, the heaviest-rulemaking decade in the program's history, with no measurable trend in either direction. That companion paper reports the fitted trends and the tests behind them; what this paper carries forward is their shape.

PHMSA has stated the reason itself. In its March 2025 advisory bulletin the agency wrote that major pipeline accidents with serious consequences are rare, and that when they occur they are "generally because of an alignment of weaknesses or failures across multiple activities." That describes a failure no single program owns. A rule can raise the standard for one activity. It

cannot on its own make several activities line up, and the alignment is exactly what this paper is about.

An outcome of that shape does not answer to the same lever as an ordinary incident. Reducing ordinary incidents can be done program by program, because one document governing one crew can carry an improvement all the way to the job. The most serious events do not work that way. They depend on the Integrity Management Program, damage prevention, one-call practice, public awareness, Operations and Maintenance, and the Operator Qualification Program all being right at the same time, across parties who do not share a document set. Program-by-program compliance moved the number it can reach and did not move the number it cannot, and Section 2.3 draws out what follows.

The record also closes off a natural objection, that the rules would have worked if only they had been enforced. *Pipeline Safety Performance and Regulatory Expansion* shows enforcement intensified across the plateau decade, hundreds of cases and tens of millions of dollars in penalties, while the fatality curve held flat regardless. More parts, and harder inspection of each part, were both tried, and neither moved the outcome.

The same bulletin recites the industry's own reporting that a safety management system now covers most pipeline mileage. That sets up the central puzzle: an industry that has adopted safety management systems across the overwhelming majority of its mileage has not seen a corresponding fall in serious outcomes. One reading, which PHMSA and NTSB adopt and which is partly true, is that the systems are not yet mature. The other, advanced here and compatible with the first, is that a safety management system sits on top of the document set and assumes it already forms a system. Where it does not, the management layer inherits the incoherence beneath it and formalizes it. You get a mature process for reviewing an incoherent set of documents.

2.3 The largest remaining gain is a coherence gain

The number that has not moved is the most serious one, and the plateau spans both the heaviest rulemaking decade in the program's history and the heaviest enforcement decade. It is therefore not for want of requirements, and it is not for want of enforcement.

Three explanations are usually offered for that, and all three are real: (1) aging distribution infrastructure, much of it installed before current materials standards; (2) population growth around pipe that was laid when the ground above it was empty; and (3) excavation damage caused by parties the operator does not employ.

Each is a genuine contributor, and operators work all three of them hard. What none of them offers is a gain an operator can complete on its own inside a budget year. Replacing legacy main is a capital program measured in decades. Encroachment is not reversible. Damage prevention programs do reduce excavation damage, and they are among the most active work in distribution, but no operator can close that exposure alone, because it involves people and systems that are not completely under the operator's control.

Coherence differs from those three in one respect that matters. It can be diagnosed and closed at the speed of documents. It needs no capital, no rulemaking, and no change in anyone else's behavior. An operator can find every place its own programs disagree with each other and fix them inside a single budget year.

It is also the only one of the four that nobody measures. There is no requirement to draw the assembly, almost no inspection question that tests it, and no score that reports it. Coverage is measured relentlessly. Coherence is measured almost nowhere.

We are not claiming that incoherence caused any particular death, and the data in this paper cannot support that claim. The claim is narrower. Of the mechanisms still standing between this industry and a serious-outcome number that finally moves, coherence is the one that sits fully inside the operator's control, needs no capital, and is not yet being worked. That makes it the largest gain still available, which is not the same thing as the largest cause. Anyone who wants that number to move should want coherence measured.

3 The car and the parts

You can have a garage full of car parts and still not have a car.

That sentence is the conclusion of *Pipeline Safety Performance and Regulatory Expansion*, and it is stated there in its final form: rules are parts, standards are parts, audits are parts, and fifteen years of requirements added more parts to the garage. This section does not introduce the analogy. It takes it apart to see what it will and will not support, because the whole argument that follows rests on one specific thing being true of it.

Where the credit belongs. The garage, the parts, and the conclusion that the missing thing is coherence are all from *Pipeline Safety Performance and Regulatory Expansion*. What 3.2 adds, the interface, the tolerance stack, the torque spec, the assembly sequence and above all the assembly drawing, is developed here. Those are what turn a memorable line into something an operator can act on.

3.1 The parts pass

Set a complete automobile's worth of parts on the garage floor and bring an inspector with a specification for each one. Every part passes: the alternator makes its rated output, the caliper holds its rated pressure, the belt meets its tensile spec. Every finding is correct, and there is no car. That is the current state of compliance inspection, with the few exceptions Section 4 returns to: a protocol scoped to a subpart reads the document that subpart requires and checks whether it contains what the subpart says it must. Ten inspections, ten passes, no system.

3.2 What actually makes a car

What converts parts into a vehicle is not in any part. It is in the relations between them:

- **The interface.** The bolt pattern, the connector pinout, the thread pitch. Two good parts that do not mate are two good parts.
- **The tolerance stack.** Every part is in spec, and the small differences add up across the assembly until the last part will not sit where it should. No per-part inspection can see it, because the defect exists only in the sum.
- **The torque spec.** The number that governs the joint belongs to neither part. It belongs to the assembly, and it lives in the assembly drawing.
- **The sequence.** Some things must be installed before others, or they cannot be installed at all.
- **The assembly drawing itself.** The single artifact that states how the parts relate. Nobody inspects it as a part. Without it there is only inventory.

3.3 Where this maps

AUTOMOTIVE	COMPLIANCE
A part	A required program, plan, or manual
Part specification	The subpart that prescribes that document's contents
Per-part inspection	Subpart-scoped document review
Interface	A dependency between two documents, such as an output one produces and another consumes
Torque spec	An acceptance criterion that governs an act described in more than one document
Tolerance stack	Accumulated drift across documents that no single document review can see
Assembly sequence	The order in which programs must be built, because later ones depend on earlier ones' outputs
Assembly drawing	The dependency map. Not currently required by any rule.
Recall propagation	Management of change under 192.13(d)
Road test	An actual field activity executed end to end

3.4 Three things the analogy supports

Adding a better part to an unassembled pile changes nothing. This is the argument against more requirements as the main lever, and the record carries it rather than intuition: the fatality count is flat across the decade in which the most parts were added. A more stringent leak-survey requirement, layered onto a document set where survey findings never reach the threat model, buys a better record of a threat nobody is acting on.

Inspecting parts harder does not detect assembly defects. This is the argument to the regulator. You can double the rigor of every per-part inspection and never test an interface, because the interface is not inside any part. The record carries this one too: enforcement intensified across the plateau decade without moving the serious-outcome trend, and enforcement is built citation by citation for the same reason the rulebook is, so it treats compliance as a set of discrete parts. Harder inspection of a pile is still inspection of a pile.

Nobody currently owns the assembly. The corrosion engineer owns the corrosion manual, the integrity engineer owns the IMP, operations owns O&M, training owns OQ. Each owner is competent and accountable for a part. The interfaces between the parts belong to no one, which is precisely where the failures accumulate.

3.5 Where the analogy breaks, and the better version

An honest paper names the limits of its own metaphor. A car is assembled once, from new parts, to a fixed drawing, by a manufacturer who owns every part. A pipeline system is none of that. The right image is not a car on an assembly line but a car kept in continuous service for fifty years by crews who never met the designer, using ten separate manuals written by ten people in ten decades, where the parts corrode in place and the conditions change under it, and no drawing shows how the manuals relate. For that vehicle the assembly drawing is not a convenience of first construction. It is the only thing that makes the fiftieth year of maintenance possible.

3.6 Why nobody has found this already

There is a fair question to ask at this point. If the seams between these documents (the joins between them, where one program hands off to the next, not gaps inside any one of them) are really where the risk sits, why has fifteen years of inspection not turned it up?

The answer is not that inspectors are not looking hard enough. It is that an inspection question has to be tied to a rule. That is what makes it defensible to ask and enforceable to act on. Almost no rule owns the space between two documents, so a question about that space has nowhere to attach. Incoherence is not being overlooked. Almost everywhere, it is out of scope by construction.

That constraint shows up in the numbers. A compliance question asks one thing: does this document meet the rule it answers to? That is a good question and it has to be asked, and the great majority of the questions an inspector carries ask exactly that, one document at a time. PHMSA's IA Question Sets run to 2,107 questions across gas distribution, gas transmission, hazardous liquid, LNG, and drug and alcohol.

About ten of them ask something better, and they are worth knowing about. The Operator Qualification questions, on both the gas and the liquid side, ask whether the procedures an evaluator used to qualify a person are the same or consistent with the procedures the operator actually uses in the field. That is a document-against-document test and a good one. The control room questions ask whether changes to field equipment that could affect control room operations are coordinated with control room personnel, and whether the records show it happened. The LNG questions check field conditions against the plot plans in the Hazard Analysis Report. Those are coherence tests, written by the agency, and they work.

What is missing is that they are exceptional. We looked for the general case and did not find it. No question we read asks whether a repair criterion in the corrosion manual matches the repair criterion in the Integrity Management Plan, or whether the damage data that feeds the annual report also reaches the Public Awareness Program, or whether the class location on the map is the class location the maintenance intervals were set from. Each test that does exist had to be written into a specific subpart by hand, one interface at a time, and only a few were.

A risk question asks something else: what can go wrong here, and would this system catch it? That question crosses documents on its own, because failures cross documents. The corrosion crew finds the deficiency and the integrity engineer never sees it. Nothing in that sentence breaks a rule. All of it is a risk.

So the goal you set decides what you are able to see. Aim at compliance and the seams are invisible. Aim at minimizing risk and the seams are the first thing you find, because they are where the information stops moving.

The goal also decides what "fixed" means. Under a compliance goal, a gap closes when the missing language is added somewhere. Under a risk goal, a gap closes when the information actually moves from the person who has it to the person who needs it. Those are different repairs, and only the second one changes the outcome.

4 What coherence means

"Coherence" is doing real work in this paper, so it needs a definition you can test rather than a gesture.

Coherence is not a new word for us. *The System You Already Have* ends on it. In plain terms it means this: a federal rule, a state requirement, and your own procedure can all govern the same job, and they need to stay tied to each other, so that changing one of them changes the others. When they are not tied, they drift apart, and nobody notices until something goes wrong. This section does not redefine coherence. It pins it down, so it can be tested and measured instead of just agreed with.

A compliance system is coherent to the degree that it has six properties.

1. Single source of truth. Every fact that comes from a requirement is stated once, and everywhere else points to that one statement. Those facts include class location, HCA status, MAOP, the established threat set, acceptance criteria, activity intervals, covered-task definitions, and role assignments. The failure state is the same fact stated

independently in three documents, where two of them are stale and nobody knows which two.

2. Traceability. Every field activity traces upward to the requirement that compels it and downward to the record that evidences it. The test is whether an operator can answer, for any given activity, both "why do we do this" and "show me" without a research project.

3. Propagation. A change to a fact upstream reaches every document that depends on it, inside a time the operator has set and stated. Propagation is not "we have a management of change procedure." It is two measured things: how long the change took to arrive, and how much of what should have moved actually moved.

4. Non-contradiction. No two documents give conflicting instruction on the same act. This is the property with the sharpest regulatory teeth, discussed in Section 6.

5. Closure. Every output has a defined consumer, and every input has a defined producer. No orphans in either direction. A close interval survey that produces data nobody is obligated to read is an orphan output. A risk model that assumes leak history nobody is obligated to structure is an orphan input.

6. Observability. You can tell how the first five are doing without reading every document. This is what makes coherence enforceable rather than a wish. If checking coherence takes as much work as the incoherence it is meant to find, no regulator will check it and no operator will keep it up.

4.1 Two of these six have real teeth

Four of the six describe where an operator wants to end up. Two of them, non-contradiction and closure, are different, because a regulatory inspector could write a finding against either one today. That difference matters, and Section 6 builds on it.

Three things coherence is not. Each one is a way the goal gets watered down until it means nothing:

It is not consolidation. Nobody is asking for one giant binder. Ten documents that agree with each other beat one document that argues with itself, and merging them usually just hides the argument inside a single cover.

It is not a matching format. A shared template and matching headers make a set of documents look connected. That is cosmetic. Coherence is about what the documents say, not how they look.

It is not completeness. A document set can have every required element and still be incoherent. Chasing completeness can even make it worse, because the quickest way to close a gap finding is to drop the missing language into whichever document is closest at hand, not the one it belongs in.

5 The document set

Federal pipeline regulation requires a specific and knowable set of written artifacts. No rule lists that set in one place and it carries no official name, so this paper names it and calls it the core ten. What follows is the list, the citation behind each item, and the hazardous liquid counterpart where one exists.

5.1 Document Zero: the applicability determination

Before the ten, there is one thing that is not usually called a document and should be.

Class location under 192.5, and high consequence area identification under 192.903 and 192.905, together determine which requirements apply to which footage. This determination is upstream of nearly everything else in the system. It is also the artifact most likely to be treated as a one-time engineering exercise rather than a maintained, versioned, governing record.

Section 192.609 requires a class location study when an increase in the number of buildings intended for human occupancy suggests a change. Section 192.611 requires confirmation or revision of MAOP when the class location changes. The regulation clearly contemplates that this determination moves. Whether an operator's downstream

documents move with it is the question this paper is about.

Part 195 has no class location. Its applicability determination is the identification of the pipeline segments that could affect a high consequence area, which 195.450 defines and 195.452 requires the operator to identify, and it behaves the same way. It governs what applies downstream, the rule expects it to be revisited, and it is easy to treat as a one-time exercise.

Treat applicability determination as Document Zero. On either side it has no subpart of its own, no inspection protocol of its own, and more downstream dependents than anything else in the set.

5.2 The core ten

#	DOCUMENT	GAS, PART 192	HAZARDOUS LIQUID, PART 195
1	Operations, maintenance, and emergency procedural manual	192.605	195.402
2	Emergency plans	192.615, brought into the manual by 192.605(e)	195.402(e), which is a paragraph of the manual section itself
3	Corrosion control program and manual	Subpart I, 192.451 through 192.491	Subpart H
4	Transmission Integrity Management Program	Subpart O, principally 192.907 and 192.911	195.452
5	Distribution integrity management plan	Subpart P, principally 192.1005 and 192.1007	No counterpart. There is no liquid distribution system.
6	Operator Qualification Program	Subpart N, principally 192.801 through 192.809	195.505
7	Damage Prevention Program	192.614	195.442
8	Public Awareness Program	192.616	195.440
9	Control room management plan	192.631, referenced by 192.605(b)(12)	195.446, referenced by 195.402(c)(15)
10	Management of change process	192.13(d), onshore gas transmission only, referenced by 192.911(k). Program-level change duties in 192.805(f), 192.631(f), and 192.937 or 192.1007(f).	No single process. Program-level change duties in 195.505(f), 195.446(f), and 195.452(f) and (j)(2). See L8.

Most operators run either #4 or #5, not both, which is how the set stays at roughly ten in practice.

A word on scope, because the citations that follow are mostly gas. This paper cites Part 192 far more than Part 195, and that is a choice about where the argument is easiest to demonstrate, not a claim about who it applies to. The structure is the same on both sides: ten documents, the same dependencies between them, and the same absence of any rule requiring anyone to draw the map. Where a hazardous liquid operator's rule does the same work as the gas rule under discussion, the linkage in Section 6 says so and gives the citation. Where it does not, and there is one place where it genuinely does not, Section 6 says that too. Two things are worth knowing up front. The liquid rules put more of the set inside one section, 195.402, than the gas rules do. And the liquid rules have no single management of change process like the one 192.13(d) requires for onshore gas transmission; their change duties sit inside the individual programs, as they

do for every gas operator, which makes the argument of this paper stronger on the liquid side rather than weaker.

5.3 The supporting register

Beyond the core ten sit a further set of required written artifacts that are less often described as standalone programs but carry the same "prepare and follow" obligation. On the gas side:

- Anti-drug and alcohol misuse prevention plans under Part 199
- Welding and joining procedure qualifications under Part 192 Subpart E
- Pressure test records and procedures under Part 192 Subpart J
- MAOP establishment and records under 192.619, and MAOP reconfirmation and material verification under 192.624 and 192.607 where applicable
- Odorization procedures under 192.625
- Incident and annual reporting under Part 191, which 192.605(b)(4) requires the manual to support
- Corrosion records under 192.491, integrity management records under 192.947, and OQ records under 192.807

The hazardous liquid side carries a register of the same kind, arranged differently:

- Anti-drug and alcohol misuse prevention plans under Part 199, which applies to hazardous liquid operators as well as gas operators
- Welding and joining procedure qualifications under Part 195 Subpart D, Construction
- Pressure test records and procedures under Part 195 Subpart E, Pressure Testing
- Maximum operating pressure under 195.406
- Accident, safety-related condition, and annual reporting under Part 195 Subpart B
- Corrosion control records under Part 195 Subpart H, and operator qualification records under Part 195 Subpart G

There is no liquid counterpart to odorization, and the liquid rules have no equivalent to the MAOP reconfirmation and material verification work that 192.624 and 192.607 create on the gas side.

The supporting register matters to this paper for one reason. Every item on it is a producer or consumer of data that the core ten depend on. They are interfaces wearing the costume of paperwork.

5.4 The general obligation that binds the whole set

A small number of provisions apply across everything above and deserve to be read together:

Section 192.13(c) requires each operator to maintain, modify as appropriate, and follow the plans, procedures, and programs it is required to establish under Part 192.

Section 192.605(a) requires each operator to prepare and follow a manual of written procedures, reviewed and updated at intervals not exceeding fifteen months but at least once each calendar year, prepared before operations commence, with appropriate parts kept where the work is done.

Part 195 states the same duty in its own words. Section 195.401(a) provides that no operator may operate or maintain its pipeline systems at a level of safety lower than that required by the subpart and the procedures it is required to establish under 195.402(a). Section 195.402(a) requires each operator to prepare and follow, for each pipeline system, a manual of written procedures for conducting normal operations and maintenance activities and handling abnormal operations and emergencies, reviewed at intervals not exceeding fifteen months but at least once each calendar year, prepared before initial operations commence, with appropriate parts kept where the work is done.

The word doing the work in all of them is *follow*. Section 6 returns to what that word means when two of your own documents disagree.

5.5 The state layer, and what it multiplies

Everything above is federal, and stated that way it understates the problem, because the federal rules are only a floor and for most mileage they are not the operative text. Under 49 U.S.C. 60105 a state may certify that it will regulate intrastate facilities to standards at least as stringent as the federal ones, and most of the country's pipeline mileage is state-inspected. "At least as stringent" is a floor, not a ceiling, and states add above it, unevenly. *Pipeline Safety Performance and Regulatory Expansion* quantifies that overlay, more than 1,500 additions above the federal floor across the participating jurisdictions, and shows how uneven it is. What that overlay does inside an operator's own documents is the point here, and it compounds three of the failure modes named in Section 8.

Three consequences follow, and each compounds a failure mode already named in Section 8.

First, the state layer does not add documents. It adds statements inside the documents that already exist. A state that prescribes leak grades and repair timelines is not requiring an eleventh document. It is overwriting a criterion inside the Operations and Maintenance Manual and inside the integrity program, both of which already state a criterion derived from the federal rule. That is single-source-of-truth failure created by rule rather than by carelessness. The operator now holds a fact that ought to be stated once and is instead stated in a federal derivation, a state derivation, and a procedure, with no artifact recording which one governs.

The clearest instance of this is not hypothetical. Section 192.605(b) is a numbered list of the procedures an Operations and Maintenance Manual must contain, running from item (1) through item (12). At least one state requires that same manual to contain three further items: classification of underground leaks, leakage surveys of underground pipelines, and the criteria identifying conditions that require shortened inspection intervals. An operator there has to satisfy one paragraph written by two governments, and no provision in Part 192 or in that state's own code requires any artifact that records which items came from which.

Second, a multi-state operator has to satisfy several overlays at once on the same page. An operator working in five states is not maintaining five document sets. It maintains one, in which some statements are national, some are state-specific, and nothing in Part 192, in Part 195, or in any state code requires an artifact that says which is which. The non-contradiction property of Section 4 is not merely unenforced here. It is materially harder to hold, and the operator carries the entire burden of holding it.

Third, change propagates through two ceilings rather than one. Every operator must carry a change through to the programs it touches: covered-task changes under 192.805(f) and 195.505(f), control room changes under 192.631(f) and 195.446(f), and, for onshore gas transmission, the analysis of implications and communication to affected parties that 192.13(d) requires. When the change originates in a state rulemaking rather than a federal one, the same duties apply and the same missing artifact defeats them, except that the operator must now also determine which of the two provisions moved.

None of this is an argument that states should add less. Section 9 reports what the evidence says about that, and the answer is not the one either side of that argument expects.

6 The connection map

This is the core of the paper. The claim is not that these documents *should* be connected as a matter of good practice. The claim is that the regulation already connects them, in text, and that the connections are usually unmanaged.

Ten linkages follow. For each: what the link is, the regulatory text that establishes it, what breaks when the link is absent, and what it looks like when it works. Figure 2 maps all ten at once, and the number on each arrow is

the linkage that carries it.

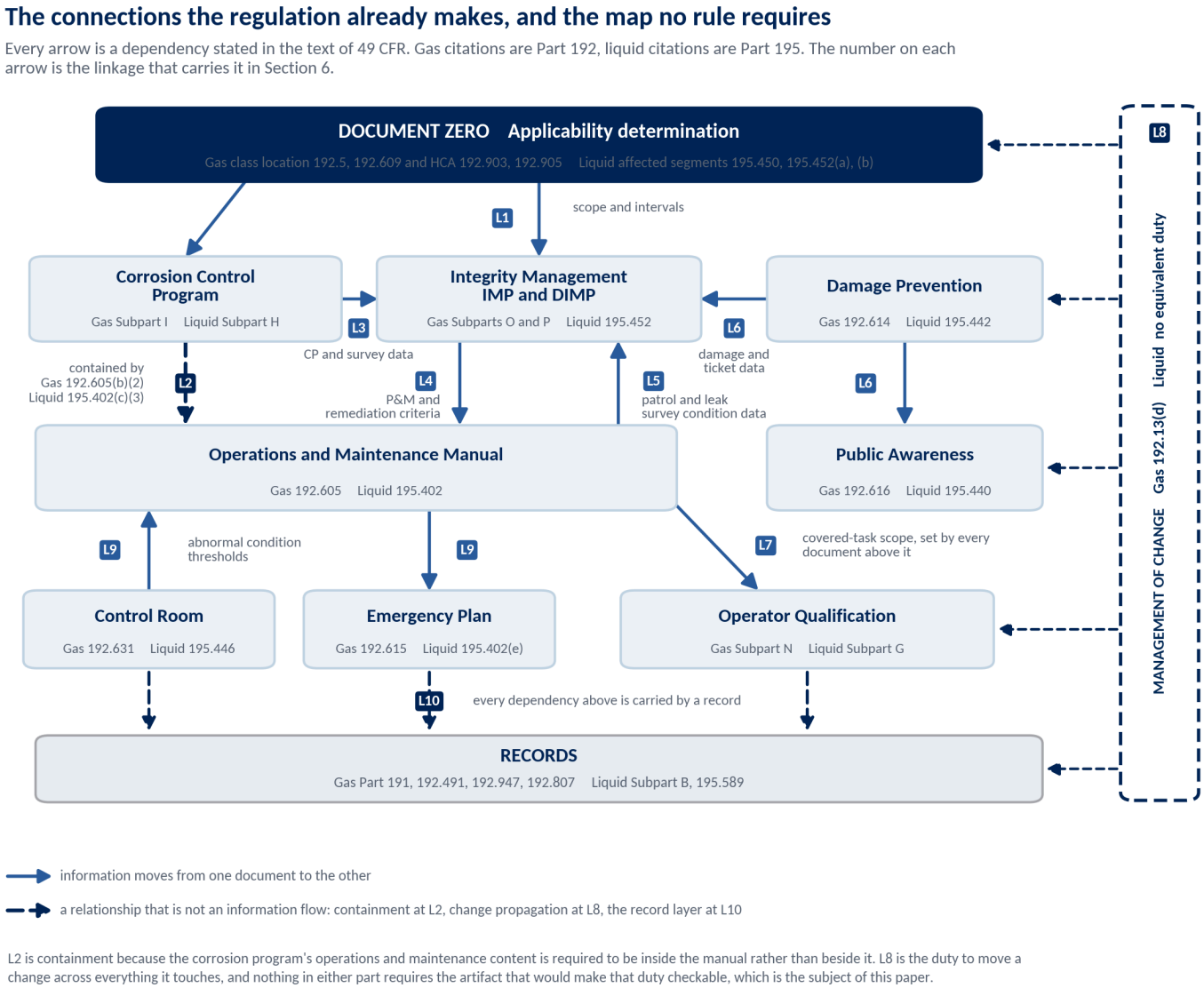

Figure 2. The ten linkages of this section drawn as one map. Every arrow is a dependency stated in the text of 49 CFR, and the number on each arrow is the linkage that carries it below. Gas citations are Part 192 and liquid citations are Part 195. The dashed arrow at L2 is containment rather than information flow, and the dashed rail at L8 is the duty to move a change across everything it touches.

L1. Applicability determination feeds nearly everything

The link. Class location under 192.5 and HCA identification under 192.903 and 192.905 determine design factor, MAOP, patrol and leak survey frequency, valve spacing, and the entire scope of the Integrity Management Program.

The text. Section 192.609 requires a class location study on an increase in occupied buildings. Section 192.611 requires confirmation or revision of MAOP when class location changes. Section 192.911(a) requires the IM program to contain an identification of all high consequence areas in accordance with 192.905, and 192.911(p) requires a process for identifying and assessing newly identified HCAs.

What breaks. A class location change is identified by one group, MAOP is revisited under 192.611, and the downstream frequency changes never happen. The O&M schedule keeps the old interval. The IMP scope never expands to the newly covered segment. Neither failure produces a finding on document review, because both

documents are internally consistent. They are consistent with a determination that is no longer true.

What it looks like working. Class and HCA status are single-sourced, versioned facts. A change to either fires a defined propagation to every dependent: MAOP, patrol interval, leak survey interval, valve spacing evaluation, IMP segment scope, and the trigger for the preventive and mitigative measures analysis under 192.935. The propagation is logged and its completion is auditable.

On the liquid side. Different in kind, identical in function. Part 195 has no class location. What it has is the identification of the pipeline segments that could affect a high consequence area, which 195.450 defines and 195.452(a) and (b)(1) require the operator to make and to carry in its written program. Section 195.452(d) then states the propagation in the rule itself: a newly identified high consequence area must be incorporated into the baseline assessment plan within one year of the date the information is obtained, and the baseline assessment of any segment that could affect it completed within five years. The liquid rule is more explicit than the gas rule that this determination moves. It is no more explicit about the other documents that have to move with it.

L2. Corrosion control is contained inside the O&M Manual by rule

The link. The corrosion program is not a peer document sitting beside the O&M Manual. Its operations and maintenance content is required to be *in* the manual.

The text. Section 192.605(b)(2) requires the manual to include procedures for controlling corrosion in accordance with the operations and maintenance requirements of Subpart I. This is not an inference. It is the second item on the list of required manual contents.

What breaks. The common industry practice is to maintain a standalone corrosion control manual and an O&M manual that also contains corrosion procedures. Two documents, two authors, two revision cycles, one subject. They drift. Within a few revision cycles the CP criteria in one no longer match the other, or the remedial trigger differs, or the survey methodology differs.

Now apply 192.13(c) and 192.605(a). The operator must follow both. When they conflict on the same act, following either violates the other. Incoherence here is not a quality problem. It is a state in which compliance is logically unavailable.

What it looks like working. One statement of each corrosion fact, in one place, referenced from wherever else it is needed. If the operator wants a standalone corrosion manual for field use, it is generated from the same source as the manual content rather than maintained in parallel.

On the liquid side. The same containment, in one section instead of two. Section 195.402(c)(3) requires the manual to carry the procedures for operating, maintaining and repairing the system in accordance with the regulations, which is where corrosion control lives, and Subpart H reaches back into that manual the way Subpart I does, at 195.555, 195.565, 195.573(d) and 195.579(d).

L3. Corrosion control produces the data integrity management consumes

The link. Corrosion is among the largest threat categories in any integrity program, and the evidence base for assessing it is produced entirely by the corrosion program.

The text. For distribution this is explicit. Section 192.1007(b) requires the operator to consider categories of threats including corrosion and atmospheric corrosion, and names the sources of data that may inform threat identification: incident and leak history, corrosion control records including atmospheric corrosion records, continuing surveillance records, patrolling records, maintenance history, and excavation damage experience.

Read that list again. It is a regulatory statement that the integrity plan runs on the outputs of at least five other documents.

For transmission, 192.911(c) requires threat identification including data integration and a risk assessment, and requires the operator to use it both to prioritize segments for assessment under 192.917 and to evaluate additional preventive and mitigative measures under 192.935. The phrase "data integration" is the whole argument in two

words. This paper does not enumerate the individual threat categories of 192.917 or trace each to its derivation in ASME B31.8S, because doing so would mean reproducing the contents of an incorporated standard. The argument here turns on the integration requirement, not on the list.

What breaks. Section 192.465(d) requires the operator to promptly correct deficiencies indicated by CP inspection and testing, and for onshore gas transmission it is considerably more specific than "promptly": a remedial action plan and any necessary permit applications within six months of the inspection that found the deficiency, and completion at the earliest of the next required inspection interval, one year not to exceed fifteen months, or six months after permits are obtained. Note what those deadlines do and do not reach. They govern the *correction*. Nothing in them governs whether the *pattern* of corrections informs anything. Suppose an operator meets every one of those deadlines, every time, correctly. The deficiency is found, corrected, and recorded in the corrosion file. If nothing obligates the threat model to consume the pattern of those deficiencies, the integrity program's external corrosion likelihood estimate is built on the assumption that the CP system works, and the record showing where it repeatedly did not sits in a different system.

The corrosion program passes its inspection. The IMP passes its inspection. The risk picture is wrong, and no document review can see it, because the defect exists only in the missing relation.

What it looks like working. CP survey results, rectifier inspections, interference bond checks, exposed pipe inspections, and atmospheric corrosion inspections are structured as threat-model inputs at the point of capture, not reconstructed from files at reassessment time. Deficiency frequency by segment is a standing input to likelihood estimation.

On the liquid side, and stated more plainly than anywhere in the gas rules. Section 195.452(g) requires an operator to analyze all available information about the integrity of the entire pipeline, and it names cathodic protection survey readings and corrosion protection information among the things that have to be brought together. Then it says something Part 192 never says anywhere: "Storing the information in a geographic information system (GIS), alone, is not sufficient. An operator must analyze for interrelationships among the data." That is this paper's argument, in the regulator's own words, already in force for every hazardous liquid operator in the country.

L4. Integrity management outputs modify O&M and corrosion control

The link. The integrity program is analytical. Its conclusions are only real when they change what someone does in the field, and what someone does in the field is specified in the execution documents.

The text. Section 192.911(h) requires provisions meeting 192.935 for adding preventive and mitigative (P&M) measures to protect the high consequence area. Section 192.935 is titled "What additional preventive and mitigative measures must an operator take?" and it requires the operator to document the risk analysis, the measures considered, and the reasons for implementing or rejecting each one. Section 192.911(e) requires provisions meeting 192.933 for remediating conditions found during an integrity assessment. Section 192.911(f) requires a process for continual evaluation and assessment meeting 192.937.

What breaks. The P&M analysis concludes that a given segment warrants increased patrol frequency, additional leak surveys, or enhanced damage prevention. The conclusion is documented in the IMP. The O&M scheduling system, the work management system, and the field procedures are never updated. The analysis is complete, defensible, and inert.

This is the single most common form of incoherence we would expect to find, because it is invisible to both sides of the review. The IMP contains a compliant P&M process. The O&M manual contains compliant patrol procedures at code minimum. Nothing in either document reveals that the first was supposed to modify the second.

What it looks like working. Every P&M determination and every remediation criterion writes to the same interval and criteria registry that the execution documents read

from. There is no such thing as an IMP conclusion that lives only in the IMP.

On the liquid side. Section 195.452(h) drives remediation back into operations, and 195.401(b)(2) requires a condition found under 195.452 to be corrected the way that section prescribes. PHMSA has an open rulemaking on the liquid repair criteria, reaching 195.401 and 195.452(h)(4) directly, which is worth knowing while reading this section: the provision that sets the repair threshold is itself being reconsidered. Which regime governs a given segment is decided by 195.450 and 195.452(d), the way 192.903 and 192.905 decide it for gas.

L5. Surveillance, patrolling, and leak survey feed the threat model

The link. The routine observational activities are the highest-frequency source of condition data in the entire system, and they are governed by the O&M Manual.

The text. Section 192.605(e) requires the procedures under 192.613(a) for continuing surveillance to be included in the O&M Manual. Section 192.1007(b) names continuing surveillance records and patrolling records among the threat identification data sources.

What breaks. Patrol observations are recorded as completion of a required activity rather than as condition data. The record proves the patrol happened. It does not carry what the patroller saw in a form anything downstream can use. Compliance is demonstrated; information is destroyed.

What it looks like working. The patrol record's primary design purpose is to feed the threat model, and demonstrating that the patrol occurred is a byproduct. Turning the record around that way is the change that gives most operators the most back for the least effort, and it costs almost nothing.

On the liquid side. The observational stream is 195.412. Surface conditions on or adjacent to each pipeline right-of-way are inspected at intervals not exceeding three weeks and at least 26 times each calendar year, and each crossing under a navigable waterway at intervals not exceeding five years. The consuming rule is 195.452(g), which requires the operator to analyze all available information about the integrity of the entire pipeline. So the liquid rules state both halves of this linkage, the activity that produces the observation and the duty to integrate what it produces, and still require no artifact showing that what the inspector saw reaches the analysis.

L6. Damage prevention connects to integrity management and to public awareness

The link. Excavation damage is a leading cause of serious incidents, and three separate documents govern the response to it.

The text. Section 192.614 requires a written Damage Prevention Program. Section 192.1007(b) names excavation damage experience as a threat data source. Section 192.1007(e)(1)(ii) and (iii) require the number of excavation damages and the number of excavation tickets as DIMP performance measures, and 192.1007(g) requires those measures reported annually as part of the 191.11 annual report. Section 192.616 requires a Public Awareness Program, and that program has required inputs and required audiences, which makes it a consumer of damage data rather than a standalone communications exercise.

What breaks. Damage data is used for the annual report and nothing else. It does not shape where the Public Awareness Program concentrates outreach, and it does not shift the integrity program's ranking of outside force damage on the segments where the damage is actually occurring. Three documents touch the same events and none of them learns from the others.

What it looks like working. Damage and near-miss location data drives awareness targeting, integrity ranking, and patrol allocation from a single dataset. The annual report is a byproduct rather than the purpose.

On the liquid side. Section 195.442 carries the damage prevention program, and it sits in the same relation to the rest of the set.

L7. Every other document determines the scope of operator qualification

The link. The covered-task list is not an independent artifact. It is a derived function of the union of activities specified across the entire document set.

The text. Section 192.805 requires a written qualification program with provisions to identify covered tasks, ensure through evaluation that individuals performing them are qualified, identify the intervals at which requalification is needed, and, critically, communicate changes that affect covered tasks to the individuals performing them. Section 192.801(b) defines what makes a task covered.

What breaks. In two directions at once. The integrity program introduces an activity, for example direct examination and non-destructive evaluation at an anomaly found by in-line inspection, and the covered-task list is never expanded, so the activity is performed by personnel who are not qualified for it. Or the operator ceased performing an activity years ago and continues to maintain qualifications, spending real money on requalification for work nobody does.

Section 192.805(f) is the coherence requirement hiding in Subpart N. The obligation to communicate changes affecting covered tasks presupposes that the operator knows which changes affect which tasks. Without a dependency map that presupposition is false, and the obligation cannot be discharged reliably even by an operator who wants to.

What it looks like working. The covered-task list is generated from the activity inventory rather than maintained beside it. Any change to an execution document that adds an activity, removes one, or meaningfully changes one triggers a covered-task evaluation automatically.

On the liquid side. Section 195.505 is the qualification program, and 195.505(f) is word for word identical to 192.805(f): "Communicate changes that affect covered tasks to individuals performing those covered tasks." The same duty, and the same silence about how anyone is supposed to know which changes those are.

L8. Management of change is a coherence requirement with no coherence artifact

The link. This is the strongest single piece of evidence in the paper.

The text. Section 192.13(d) requires each operator of an onshore gas transmission pipeline to evaluate and mitigate significant changes that pose a risk to safety or the environment through a management of change process, and to develop and follow that process as outlined in ASME B31.8S section 11, addressing technical, design, physical, environmental, procedural, operational, maintenance, and organizational changes, whether permanent or temporary. The process must include: reason for change, authority for approving changes, analysis of implications, acquisition of required work permits, documentation, communication of change to affected parties, time limitations, and qualification of staff.

For segments outside Subpart O this had to be implemented by February 26, 2024, with an extension mechanism under 192.18. It does not apply to gas gathering. Section 192.911(k) pulls the same MOC obligation into the Integrity Management Program.

Why this matters more than anything else cited here. Read the required elements again with the coherence lens.

Analysis of implications. Implications for what? For the rest of the system. That analysis is a dependency traversal.

Communication of change to affected parties. Which parties are affected? The ones downstream of the changed fact. Identifying them is a dependency lookup.

Qualification of staff. Which qualifications? The ones attached to tasks the change touches. Another dependency lookup.

Section 192.13(d) is, in substance, a requirement to propagate changes correctly across the document set. It presumes the existence of an artifact that states what depends on what. No provision in Part 192 requires an operator to produce that artifact. Every onshore gas transmission operator is therefore required to execute a process whose correct execution depends on something no rule requires them to have.

Most operators fill that gap with institutional memory: a long-tenured person who knows that changing the CP criteria means someone should probably look at the O&M Manual and the OQ list. That works until that person retires. The regulation has, without quite saying so, made a coherence artifact mandatory in effect and optional in form.

What it looks like working. Management of change runs against a written dependency map. Working out the implications of a change means walking that map and checking that nothing on it was missed, rather than relying on somebody's judgment about what else might be affected. Two things get measured: how long the change took to reach everything it touches, and how much of what should have moved actually moved.

On the liquid side, and for every operator 192.13(d) does not reach. Both parts require change to be managed inside individual programs, and largely in the same words. Changes that affect covered tasks must reach the people performing them under 192.805(f) and 195.505(f), word for word. Changes that could affect control room operations must be coordinated with control room personnel under 192.631(f) and 195.446(f), and a point-to-point verification is required when field equipment or SCADA displays change under 192.631(c)(2) and 195.446(c)(2), again in the same words. The integrity program must keep evaluating and changing: under 192.937 for gas transmission, 192.1007(f) for gas distribution, and for liquid under 195.452(f), which requires the operator to "continually change the program to reflect operating experience, conclusions drawn from results of the integrity assessments, and other maintenance and surveillance data," and 195.452(j)(2). What Part 195 lacks is the single process. It has no management of change process with listed elements equivalent to 192.13(d): the phrase does not appear in 195.402, and the eight required elements of a liquid integrity program at 195.452(f) do not list one, where 192.911(k) does for gas transmission. Gas distribution and gas gathering operators, which 192.13(d) does not reach, stand in the same place. Each of those operators is required to manage change inside every program, and no single provision ties those duties together or says what else a given change touches.

L9. The control room connects to O&M abnormal operations and to emergency response

The link. The control room detects the condition. The abnormal operating procedures govern the immediate response. The emergency plan governs escalation. Three documents, one event, seconds to minutes of decision time.

The text. Section 192.605(b)(12) requires the O&M Manual to include procedures for implementing the applicable control room management procedures required by 192.631. Section 192.605(c) requires transmission manuals to include abnormal operation procedures covering unintended valve closure or shutdown, pressure or flow outside normal limits, loss of communications, operation of any safety device, and other foreseeable malfunctions or personnel errors. Section 192.605(e) requires the emergency procedures under 192.615 to be in the manual.

What breaks. The escalation thresholds do not match. The CRM plan defines a condition warranting notification at one threshold; the abnormal operations procedure defines investigation at another; the emergency plan defines activation at a third. Under normal operation nobody notices. Under a rupture, the controller is reconciling three documents in real time.

The relevance here is not theoretical. PHMSA's March 2025 advisory bulletin recites NTSB's finding that both the 2010 Marshall and San Bruno accidents involved errors at management and operator levels in both integrity and control center operations, and that delays in recognizing and responding to the rupture were prominent in both. Those are interface failures between detection, response, and escalation.

What it looks like working. One set of thresholds and one escalation ladder, referenced by all three documents rather than restated in each. The controller sees one decision tree.

On the liquid side. The same three-document knot. Section 195.402(c)(15) puts the control room procedures inside the manual, 195.446 is the control room rule itself, and 195.402(e)(10) requires the emergency procedures to state what the controller does.

L10. Records are the connective tissue, not the residue

The link. Every dependency in L1 through L9 is carried by a record. If the record is structured for proof rather than for use, the dependency cannot function even when everyone intends it to.

The text. Section 192.603(b) requires each operator to keep records necessary to administer the procedures established under 192.605. Section 192.491 governs corrosion control records. Section 192.947 governs integrity management records. Section 192.807 governs qualification records. Section 192.605(b)(3) requires the manual to include procedures for making construction records, maps, and operating history available to appropriate operating personnel. Section 192.605(b)(4) requires procedures for gathering the data needed for Part 191 incident reporting in a timely and effective manner.

What breaks. Records are designed backward from the inspection. The question the record is built to answer is "can we prove we did it," which is a yes or no. The question the downstream document needs answered is "what did we find, where, how bad, and how does that compare to last time," which is structured data. A record optimized for the first destroys the information needed for the second.

What it looks like working. Records are designed forward from their consumers. The compliance demonstration falls out of a record built to feed the threat model, not the other way around.

On the liquid side. Section 195.402(c)(2) puts the accident data-gathering procedure in the manual, 195.402(f) carries the safety-related condition duty, 195.50 defines what is reportable, and 195.589 sets corrosion record retention.

6.1 The pattern across all ten

Three observations hold across the linkages above.

The regulation asserts the connections and never requires the map. In 192.605(b)(2), (b)(12), and (e), four of the ten documents are declared to be contents of a fifth. That is a Part 192 count. Part 195 arranges the same containment differently, inside 195.402(c) and (e), and the liquid equivalent is not counted here. In 192.1007(b), the integrity plan is declared to run on the outputs of five others. In 192.13(d) and 192.805(f), operators are required to propagate changes to affected parties and affected tasks. Not one of these provisions requires the operator to document what depends on what.

Almost every failure mode described above is invisible to document review. In L1 through L10, both documents remain internally compliant. The defect exists only in the relation. The exceptions are the handful of places where a rule reached across, named in Section 4. This is not a criticism of inspectors, who are executing the protocol they have. It is a description of what that protocol was not built to detect.

Nearly all of the incoherence is silent. Contradictions are the loud failure and the rare one. The common failures are propagation failures and orphan outputs, where nothing conflicts and nothing is missing and information simply fails to move. Silence is what makes this a risk problem rather than a paperwork problem.

7 Sequencing falls out of the map, it is not a separate argument

The argument that the Integrity Management Program and corrosion control manual should be built before the O&M Manual is a specific instance of the general claim. It falls out of the connection map on its own, with nothing else added.

The general principle. Documents that *determine* what must be done, how often, and against what criterion must precede documents that *specify how to do it*. Determination is upstream of execution. Building execution first means building it around placeholders, then rebuilding it when the determinations land.

The chain. Records and asset baseline, then applicability determination under L1, then threat identification and risk assessment plus corrosion system design and criteria,

then the derived task inventory with intervals and acceptance criteria, then the O&M procedures, then the OQ covered-task list under L7, then forms and records under L10.

The specific case. Section 192.605(b)(2) settles it textually: the manual must incorporate corrosion control per Subpart I. You cannot write the manual before the material it is required to carry exists. Beyond the text, corrosion generates the largest recurring task inventory of any single threat area, so drafting O&M before the corrosion program is defined means drafting the largest part of the manual speculatively. And the IM preventive and mitigative analysis under 192.935 systematically produces obligations above code minimum, so an O&M manual written first will be written to minimums and reissued.

What decides it. The two documents are not alike in how often they move. The IMP is designed to change, with reassessment and continual evaluation cycles built into it under 192.937. The O&M manual is the most widely distributed, most trained-against, and most inspected document the operator owns, and every revision triggers distribution control, retraining, and evidence. Sequence the volatile analytical work first and the stable execution document last.

Two honest qualifications. Nothing in Part 192 mandates this order, and the paper should not imply otherwise; this is an authoring-efficiency and internal-consistency argument. And a new operator cannot operate without a manual, since 192.605(a) requires it before operations commence. For greenfield, the defensible approach is a controlled skeleton manual that cross-references the IMP and corrosion program as governing for criteria and intervals, completed as those land, with no substantive corrosion or repair criteria written into the skeleton.

Where this does not hold. For distribution operators the dependency runs both ways, because DIMP under 192.1007(a) and (b) leans heavily on the operational knowledge and leak history that the O&M program itself produces. So this sequencing argument is made for transmission, gathering and hazardous liquid. It is not made for distribution.

8 Naming the ways coherence fails

If coherence is going to be managed, its failures need names. Eight of them, each with the rule that makes it actionable.

1. Orphan output. A document produces data no other document is obligated to consume. *Example:* close interval survey results filed and never entering the threat model. *Hook:* 192.1007(b) for distribution; 192.911(c) data integration for transmission.

2. Orphan input. A document assumes data no other document is obligated to produce. *Example:* a risk algorithm weighted on coating condition where no activity produces coating condition data in the detail the algorithm needs. *Hook:* 192.911(c); 192.917.

3. Contradiction. Two documents give conflicting instruction on the same act. *Example:* differing remediation thresholds in the corrosion manual and the IMP. *Hook:* 192.13(c) and 192.605(a). Following one violates the other.

4. Stale reference. A document cites a criterion, interval, or determination that has since changed elsewhere. *Example:* O&M patrol frequency reflecting a superseded class location. *Hook:* 192.13(c) maintain and modify; 192.605(a) annual review.

5. Propagation failure. An upstream change occurs and downstream documents never move. *Example:* a P&M determination under 192.935 that never reaches the work scheduler. *Hook:* 192.13(d) analysis of implications and communication to affected parties.

6. Scope mismatch. The covered-task list diverges from the activities actually specified. *Example:* dig NDE performed without a corresponding covered task. *Hook:* 192.805(a), (f), and (g); 192.801(b).

7. Evidence gap. An activity is performed correctly and the record structure cannot demonstrate it or cannot feed the consumer. *Example:* patrol records that prove occurrence and carry no observation data. *Hook:* 192.603(b); 192.491; 192.947.

8. Ownership gap. A dependency exists and no role is accountable for it. *Example:* nobody owns the relation between corrosion findings and integrity threat weighting. *Hook:* 192.13(d) authority for approving changes; 192.911(k). This mode is the generator of the other seven.

The same eight modes on the liquid side. Part 195 supplies most of the same hooks in fewer places. Sections 195.401(a) and 195.402(a) together do the work that 192.13(c) and 192.605(a) do on the gas side, so contradiction and stale reference are actionable the same way. For orphan output and orphan input the hook is 195.452(g), which is stronger than anything in Part 192 because it says outright that holding the information is not the same as analyzing it. Scope mismatch runs through 195.505(f), which is word for word identical to 192.805(f): "Communicate changes that affect covered tasks to individuals performing those covered tasks." Corrosion records under Part 195 Subpart H carry the evidence-gap hook.

Two modes rest on a general hook only for onshore gas transmission. Propagation failure and ownership gap are actionable under 192.13(d) where it applies. Every operator, gas or liquid, also carries the program-level duties that reach them: 192.805(f) and 195.505(f) for covered tasks, 192.631(f) and 195.446(f), both headed "Change management," for the control room, and the integrity program duties under 192.937, 192.1007(f), and 195.452(f) and (j)(2). Each reaches its own program. Outside onshore gas transmission, none ties them together, which is the same asymmetry L8 describes.

Naming them is what makes coherence measurable. Each of the eight can be found on its own, fixed on its own, and counted on its own, which is the difference between a number and an adjective.

9 Why adding requirements has stopped moving the number

This section states a model. It is a model, not a finding, and Section 11 says so again more forcefully.

The proposition. Parts grow steadily as regulation grows. The connections between them grow much faster. Regulation specifies the parts and does not specify the connections. So the share of the system that is actually covered gets smaller as the rulebook gets bigger.

The arithmetic. Count the parts, then count the pairs. Four documents can be paired six ways. Ten documents can be paired forty-five ways. So going from four required programs to ten roughly doubles the parts and multiplies the possible connections between them by more than seven. Every rulemaking that adds a program adds one part that gets inspected and a handful of connections that do not.

One caution. That is an illustration, not a measurement. Not every pair of documents actually depends on the other, so the real number of live connections is far smaller than forty-five and does not grow anything like that fast. The version of the claim worth defending is the modest one, and it is enough: **the connections grow faster than the parts, and only the parts are written down and inspected.**

Why this predicts a plateau specifically in serious outcomes. Routine failures tend to be single-part failures, which per-part regulation addresses well. That is the improvement the record shows. Serious outcomes are disproportionately multi-factor. PHMSA's own framing in the March 2025 advisory bulletin describes serious accidents as an alignment of weaknesses across multiple activities. If serious outcomes are produced at interfaces and regulation acts on parts, then a regime that adds parts should reduce routine failures substantially and serious outcomes far less. That is the shape of the record.

Why the SMS layer has not closed it. API RP 1173 is the right idea at the right level, and PHMSA and NTSB are

right to promote it. But a management system operates on the document set; it does not restructure it. It adds review, assurance, and management commitment on top of whatever is underneath. Where what is underneath is ten adjacent systems, a mature PSMS produces a mature process for managing ten adjacent systems. That is consistent with high adoption and flat serious-outcome trends, though it is not the only explanation consistent with them.

The objection this section can now close. The strongest reply is that the rules were fine and enforcement was weak. The record answers it. As *Pipeline Safety Performance and Regulatory Expansion* shows, enforcement intensified across the plateau decade, hundreds of cases and tens of millions of dollars in penalties, while the fatality count held flat, so more parts and harder inspection of each part were both tried and neither moved the outcome. That companion paper runs the same test at the state layer and reaches the same answer: how far a state goes above the federal floor has no relationship to its reported incident record. At neither level of government does the sheer volume of requirements distinguish the outcome.

What that does and does not establish. It does not establish that any particular state requirement is useless, and it does not account for the exposure differences that make one state's job harder than another's, which are large. Comparing states against each other on small numbers of rare events is a weak test, and this one is no exception. What it does establish is that the most obvious alternative explanation for the plateau is unsupported at either level of government. Adding requirements did not move the national number across the heaviest federal rulemaking decade, and the amount a state adds on top of the federal floor does not distinguish that state's outcome record. Two governments, two separate measures of how many requirements there are, and the same answer both times: no connection. That is the point at which the plateau stops looking like a question of how many requirements there are.

The claim this section supports and the claim it does not. It supports: the marginal return on additional prescriptive requirements is low, and there is an unaddressed structural property where the remaining risk plausibly concentrates. It does not support: that incoherence has been shown to cause any particular fatality. Nobody has run that analysis, and until somebody does, this stays a hypothesis.

10 For operators: what changes

The operator case does not require accepting any of the regulatory argument. It stands on cost.

Author once. Every fact stated in three documents is authored three times and revised three times forever. Single-sourcing removes duplicated authoring permanently, and the savings compound with every revision cycle.

Change once. Today a change to a corrosion criterion means finding every document that restates it, which is a research task whose accuracy depends on someone's memory. Against a dependency register it is a lookup. This is also, not incidentally, how an operator actually satisfies 192.13(d).

Train once. Retraining is triggered by document revision. Fewer redundant revisions, less retraining, and less of the specific failure where crews are trained to a superseded version because the distribution list was built for a different document.

Audit by construction. Most audit preparation is reconstruction: assembling after the fact the trace from requirement to activity to evidence that should have existed continuously. A coherent system holds that trace as a standing property. The preparation cost approaches zero because the artifact already exists.

Fewer findings, and cheaper ones. Contradictions and stale references are findable by an inspector reading two documents on the same day. They are also among the easier findings to write up, because the evidence is the operator's own text.

The risk argument, which is the one that matters. Every failure mode in Section 8 is a mechanism by which an operator does everything its documents require and remains exposed. The corrosion crew does its job. The integrity engineer does hers. The information does not move between them. Nobody is negligent and the risk picture is wrong. Coherence work is not compliance overhead. It is the only work that addresses that specific class of exposure.

Where to start, in order. Draw the map before changing anything. Then: single-source the acceptance criteria, because contradiction is the sharpest exposure. Then single-source the intervals. Then restructure the highest-frequency records to feed their consumers, starting with patrol and leak survey. Then rebuild the covered-task list as a derived artifact. Then attach MOC to the map. The first two steps are weeks of work at a mid-size operator and remove most of the legal exposure.

11 Objections, and what this paper does not prove

These are the objections we expect, and we would rather answer them here than have someone else raise them first.

"This is API RP 1173 with different words." Partly fair, and the part that is not fair is the part that matters. RP 1173 is the closest existing analogue, this paper is aligned with its intent, and the industry deserves the credit for getting there first. Two things separate them.

The first is structural. RP 1173 specifies a management system and assumes an underlying set of programs. Coherence is a property of that underlying set. The first edition does not specify a dependency artifact, does not define propagation completeness, and does not provide a taxonomy of interface failures. Adoption across most industry mileage without a corresponding change in serious outcomes is at least consistent with that assumption not holding.

The second is that RP 1173 is not a regulatory document and has never claimed to be. It is a voluntary recommended practice. No rule requires it, it is not incorporated by reference into Part 192 or Part 195, and it is not organized around the requirements of either. It does not map its ten elements onto the programs the regulations require, because that was never what it was written to do. So the connection between the required document set and the elements of a safety management system is not something this paper inherited. It is the argument this paper is making: wire regulatory compliance into the management system, and let compliance become a quiet by-product of running a good one rather than a separate exercise conducted alongside it. That claim belongs to this paper and not to the recommended practice, and it should be argued with on its own terms.

"Isn't this just 'follow your procedures'? 192.605 and 192.13(c) already require it." Yes, and that is the point, not the flaw. The authority is already there, which is why coherence needs no new rule. But 192.13(c) and 192.605(a) only bite where someone can see that two of an operator's own documents govern the same act and disagree. Nothing in the rulebook draws that map, so the citation has teeth it cannot reach. Coherence is the map. Follow-your-procedures is the hook; the dependency map is what lets it find the seam instead of the missing sentence.

"You cannot enforce a quality property." Regulators already do. "Adequate procedures" is a quality judgment made routinely. Coherence is easier to judge than adequacy, not harder. Two documents either contradict each other or they do not, and an output either has a consumer or it does not.

"Small operators cannot afford this." The reverse is more likely. Coherence is cheaper than redundancy, and the smallest operators have the fewest documents and the simplest maps. PHMSA's August 2024 report to Congress found, per the March 2025 advisory bulletin's summary, that more than half of the smallest category of operators described their PSMS efforts as stalled. A lighter structural approach may be more accessible to exactly that

population than a full management system. This should be tested rather than asserted.

"Coherence just becomes another checkbox." This is the objection we have the least good answer to, and we will not pretend otherwise. Any property that gets enforced gets gamed, and a dependency register can be produced as a compliance artifact and never used. The partial answer is that thread audits and propagation latency test behavior rather than documentation, which is harder to fake than a register. The honest answer is that the risk is real and this paper does not eliminate it.

"Your state numbers are a ranking of state programs, and readers will take them as one." They are not, and they should not be. No jurisdiction is named anywhere in this paper as a data point, and the only three named at all are named because they sit outside the test. Nothing here compares one state program's performance to another's, this paper publishes no state ranking, and it will not. The state analysis tests one thing, how many requirements a state adds above the federal floor, against that state's outcome record, and it finds no relationship. Two features of the data make the ranking reading unavailable even to someone who wanted it. The exposure differences between states are enormous and are not controlled for: services per mile of main, legacy cast iron and bare steel mileage, class location, and operator population each vary by more than an order of magnitude, and any one of them swamps the variable being tested. And the annual outcome counts per state are small enough that a single incident moves a state several places. Section 2.2 is held to the same discipline: gas distribution carries most of the remaining exposure because that is where gas enters occupied buildings, not because of who inspects it. Where the numbers in this paper invite a comparative reading, the comparative reading is unsupported, and we will say so in these same words if anyone else advances it.

"You have not shown that incoherence causes fatalities." Correct. We have not. What exists is: a regulator's own statement that serious accidents arise from alignment of weaknesses across multiple activities; regulatory text that establishes cross-document dependencies; and a mechanism by which those dependencies fail silently. That is a well-supported hypothesis, not a demonstrated causal chain. Publishing it as more than that would be the same error this paper criticizes.

"Sequencing is not legally required." Also correct, and Section 7 says so. The sequencing argument is about authoring efficiency and internal consistency, not legal ordering.

12 What we are suggesting to operators

Draw the map. Not as a deliverable for anyone else, and not as a prelude to a project. Take the ten documents and, for each, list what it consumes and what it produces. Many operators have never written that down. If you did, you would quickly find both problems this paper is about: a record somebody produces on a schedule that nobody downstream reads, and a single question two documents answer differently. That is this whole paper, in a form that takes one internal meeting.

Appendix A: Producer and consumer matrix

The rows below are general. They hold for the requirements as written, and an operator's own version of this matrix carries its own document names, roles and intervals.

FACT OR OUTPUT	PRODUCED BY	CONSUMED BY	HAZARDOUS LIQUID COUNTERPART
Class location determination	Doc Zero (192.5, 192.609)	MAOP (192.611, 192.619); patrol and leak survey intervals; valve spacing; IMP scope	No class location in Part 195
HCA identification	Doc Zero (192.903, 192.905)	IMP scope (192.911(a), (p)); P&M (192.935)	195.450 definition; 195.452(a), (b) identification; 195.452(d) newly identified areas
CP criteria and test point plan	Corrosion program (Subpart I, 192.463)	O&M manual (192.605(b)(2)); OQ covered tasks; records (192.491)	195.563; 195.567 test leads; 195.571 criteria; records 195.589
CP survey and rectifier results	Corrosion program (192.465)	Threat model (192.1007(b); 192.911(c)); remediation trigger (192.465(d))	195.573 monitoring; consumed by 195.452(g)
Atmospheric corrosion inspection results	Corrosion program (192.479, 192.481)	Threat model (192.1007(b))	195.581, 195.583; consumed by 195.452(g)
Threat identification and risk ranking	IMP (192.911(c), 192.917; 192.1007(b), (c))	Assessment prioritization; P&M (192.935); resource allocation	195.452(e) risk factors; 195.452(g) information analysis
P&M determinations	IMP (192.911(h), 192.935)	O&M intervals; damage prevention; patrol allocation	195.452(i)
Remediation criteria	IMP (192.911(e), 192.933)	Field repair procedures; O&M; OQ	195.452(h); corroded pipe 195.585
Patrol and surveillance observations	O&M (192.605(e), 192.613(a))	Threat model (192.1007(b))	195.412 right of way and crossings
Leak survey and repair history	O&M (Subpart M)	Threat model; DIMP performance measures (192.1007(e))	No periodic leak survey counterpart; 195.412 is the nearest producer
Excavation damage and ticket data	Damage prevention (192.614)	Threat model; public awareness targeting (192.616); annual report (192.1007(g), 191.11)	195.442; public awareness 195.440; reporting Part 195 Subpart B
Activity inventory	All execution documents	OQ covered-task list (192.805(a))	195.505
Covered-task changes	Any document change	OQ notification (192.805(f)); MOC (192.13(d))	195.505(f), word for word identical to 192.805(f)
Abnormal condition thresholds	CRM (192.631); O&M (192.605(c))	Emergency plan activation (192.615)	195.446; emergency procedures 195.402(e)

FACT OR OUTPUT	PRODUCED BY	CONSUMED BY	HAZARDOUS LIQUID COUNTERPART
Change records	MOC (192.13(d), onshore gas transmission)	Every affected document, task, and role	No single process, as for gas distribution and gathering. Program-level duties: 195.452(f) and (j)(2); 195.505(f); 195.446(f)

Note: this matrix names each dependency. It does not name the direction of authority inside it, or who owns it. Two more columns, the role that owns the row and how quickly a change has to reach the far end, are what turn it into a working document.

Appendix B: Citation register and verification status

Every citation in this paper was checked twice, against two independent copies of the rule. This appendix says how far each one was checked, so you can weigh them for yourself. One limit runs through all of it, and it is stated once here rather than repeated at every entry: a second copy of the rule confirms that we have not misread a section, not that the section is current. Parts 192 and 195 both change. Read the current text of any provision before acting on it.

Confirmed verbatim in both sources, Part 192:

- 192.13(c) - "Each operator shall maintain, modify as appropriate, and follow the plans, procedures, and programs..."
- 192.13(d) - management of change, including the ASME B31.8S section 11 incorporation and the full element list: reason for change, authority for approving changes, analysis of implications, acquisition of required work permits, documentation, communication of change to affected parties, time limitations, and qualification of staff. **This is the load-bearing citation of the paper, and it is confirmed word for word.**
- 192.465(d) - prompt correction, and the onshore transmission deadline structure quoted in L3.
- 192.605(b)(2) - "Controlling corrosion in accordance with the operations and maintenance requirements of subpart I of this part."
- 192.605(e) - "The procedures required by 192.613(a), 192.615, and 192.617..."
- 192.805(f) - "Communicate changes that affect covered tasks to individuals performing those covered tasks."
- 192.911(c) - "An identification of threats to each covered pipeline segment, which must include data integration and a risk assessment."
- 192.911(k) - "A management of change process as required by 192.13(d)."
- 192.1007(b) - threat categories and the named data sources: "incident and leak history, corrosion control records (including atmospheric corrosion records), continuing surveillance records, patrolling records, maintenance history, and excavation damage experience." **The second-strongest citation of the paper, confirmed word for word.**

Confirmed verbatim in both sources, Part 195:

- 195.401(a) - "No operator may operate or maintain its pipeline systems at a level of safety lower than that required by this subpart and the procedures it is required to establish under 195.402(a) of this subpart."
- 195.402(a) - "Each operator shall prepare and follow for each pipeline system a manual of written procedures for conducting normal operations and maintenance activities and handling abnormal operations and emergencies."
- 195.412(a) - "Each operator shall, at intervals not exceeding 3 weeks, but at least 26 times each calendar year, inspect the surface conditions on or adjacent to each pipeline right-of-way."
- 195.446(f) - "Change management. Each operator must assure that changes that could affect control room operations are coordinated with the control room personnel."
- 195.452(f) - "An operator must continually change the program to reflect operating experience, conclusions

drawn from results of the integrity assessments, and other maintenance and surveillance data, and evaluation of consequences of a failure on the high consequence area."

- 195.452(g) - "Storing the information in a geographic information system (GIS), alone, is not sufficient. An operator must analyze for interrelationships among the data." **This is the argument of this paper in the regulator's own words, and it is confirmed word for word.**
- 195.505(f) - "Communicate changes that affect covered tasks to individuals performing those covered tasks." Word for word identical to 192.805(f).

Present in the register and consistent with this paper, though not compared line by line. Section titles and Active status confirmed for 192.5, 192.463 with Part 192 Appendix D, 192.479, 192.481, 192.491, 192.603, 192.607, 192.609, 192.611, 192.613, 192.614, 192.615, 192.616, 192.617, 192.619, 192.624, 192.625, 192.631, 192.703, 192.705, 192.706, 192.801, 192.807, 192.903, 192.905, 192.917, 192.933, 192.935, 192.937, 192.945, 192.947 and 192.1005. On the liquid side the same applies to 195.406, 195.419, 195.440, 195.442, 195.450, 195.505, 195.563, 195.567, 195.571, 195.573, 195.581, 195.583, 195.585, 195.588, 195.589 and 195.591, to the paragraph headings of 195.452 from (a) through (n), and to Part 195 Subparts B, D, E, G and H. These are cited for their subject matter. Every claim this paper makes about a specific subsection's wording is in the verbatim lists above.

One citation that took extra work. Section 192.605(b)(12), the control room management hook, carries linkage L9 and part of the Section 6.1 claim that four of the ten documents are named contents of a fifth. Because it does that much work, it was pulled twice from separate sources, on August 19 and again on September 4, 2026. Both agree. It reads, in full: "Implementing the applicable control room management procedures required by 192.631."

A neighboring provision, stated precisely, because it is easy to overstate. Item (11) of the same paragraph requires procedures for responding promptly to a report of a gas odor inside or near a building, unless the operator's emergency procedures under 192.615(a)(3) specifically apply to those reports. That is a cross-reference used as an exception, not a declaration that the emergency procedures are contents of the manual. It does not add to the Section 6.1 count, and 192.605(e) carries that point on its own terms.

The vacatur. Section 192.478 now reads "[Reserved]". That is consistent with the corrections that removed it after the D.C. Circuit struck down part of the 2022 rule in August 2024, and it was confirmed against eCFR on September 4, 2026.

Secondary and contextual sources.

- PHMSA Advisory Bulletin ADB-2025-01, "Pipeline Safety: Pipeline Safety Management System," 90 FR 13658, March 25, 2025, Docket PHMSA-2025-0018. Source of the alignment-of-weaknesses characterization; the 85 percent and 86 percent PSMS coverage figures as recited from the industry annual report and PHMSA's collection; the recital of NTSB findings on Marshall and San Bruno; the small-operator finding from PHMSA's August 2024 report to Congress; and the statement that advisory bulletins do not have the force of law. The coverage percentages are secondhand within that bulletin, which credits the 85 percent figure to the Pipeline SMS 2023 Annual Report and the 86 percent figure to a 2023 PHMSA information collection. The small-operator finding is the one the bulletin traces to PHMSA's August 2024 report to Congress.
- NTSB Safety Alert SA-095, "Pipeline Safety Management Systems: Vital for the Safe Operation of Pipelines," January 2024. Cited here via the advisory bulletin.
- NTSB Safety Recommendations P-12-17, to API following Marshall, and P-24-002, to PHMSA following San Pedro Bay. Cited via the advisory bulletin.
- API RP 1173, Pipeline Safety Management Systems, first edition July 2015, reaffirmed April 2023, as the advisory bulletin cites it; Errata 1 issued 2025. Ten essential elements, which this paper deliberately does not enumerate.
- PIPES Act of 2020, Pub. L. 116-260, section 205, directing promotion of pipeline safety management systems.
- INGAA v. PHMSA, D.C. Circuit, August 16, 2024, reported at 114 F.4th 744, vacating portions of the 2022 Gas Transmission Final Rule for inadequate cost-benefit analysis. PHMSA published conforming

corrections effective January 15, 2025, removing vacated provisions including 192.478 and vacating certain provisions as applied to high-frequency ERW seams.

The one negative claim about Part 195, stated precisely. This paper says in several places that Part 195 has no single management of change process equivalent to 192.13(d). A negative is harder to show than a citation, so here is how to check it: the phrase does not appear in 195.402, and the required elements listed in 195.452(f) do not include one. That is a statement about form, not a claim that liquid operators need not manage change. Part 195 requires change to be managed inside the same programs Part 192 does: 195.452(f) and (j)(2) for the integrity program, 195.505(f) for covered tasks, and 195.446(f) and (c)(2) for the control room, matching 192.937 and 192.1007(f), 192.805(f), and 192.631(f) and (c)(2) on the gas side. It also carries narrower change duties at 195.588(b)(4)(iii) for changes to an ECDA plan and 195.419(f) where changed operating conditions could affect the set pressures of an automatic shut-off valve used as a rupture-mitigation valve. Section 192.13(d) itself reaches only onshore gas transmission, so gas distribution and gas gathering operators stand where liquid operators do.

Recency, and the three citations that moved. Part 195 has been amended twice by periodic standards rules since these citations were first collected, the second of them effective January 10, 2026. Three provisions cited in this paper sit in those amendments: 195.565, 195.573(d) and 195.579(d), all in corrosion control. PHMSA also has active rulemaking in gas gathering, MAOP reconfirmation, leak detection and repair, and repair criteria.

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Prepared by Systemic Compliance. Regulatory citations pulled from eCFR. Performance figures computed from PHMSA incident and accident report files.