Perspective on Energy Pipelines

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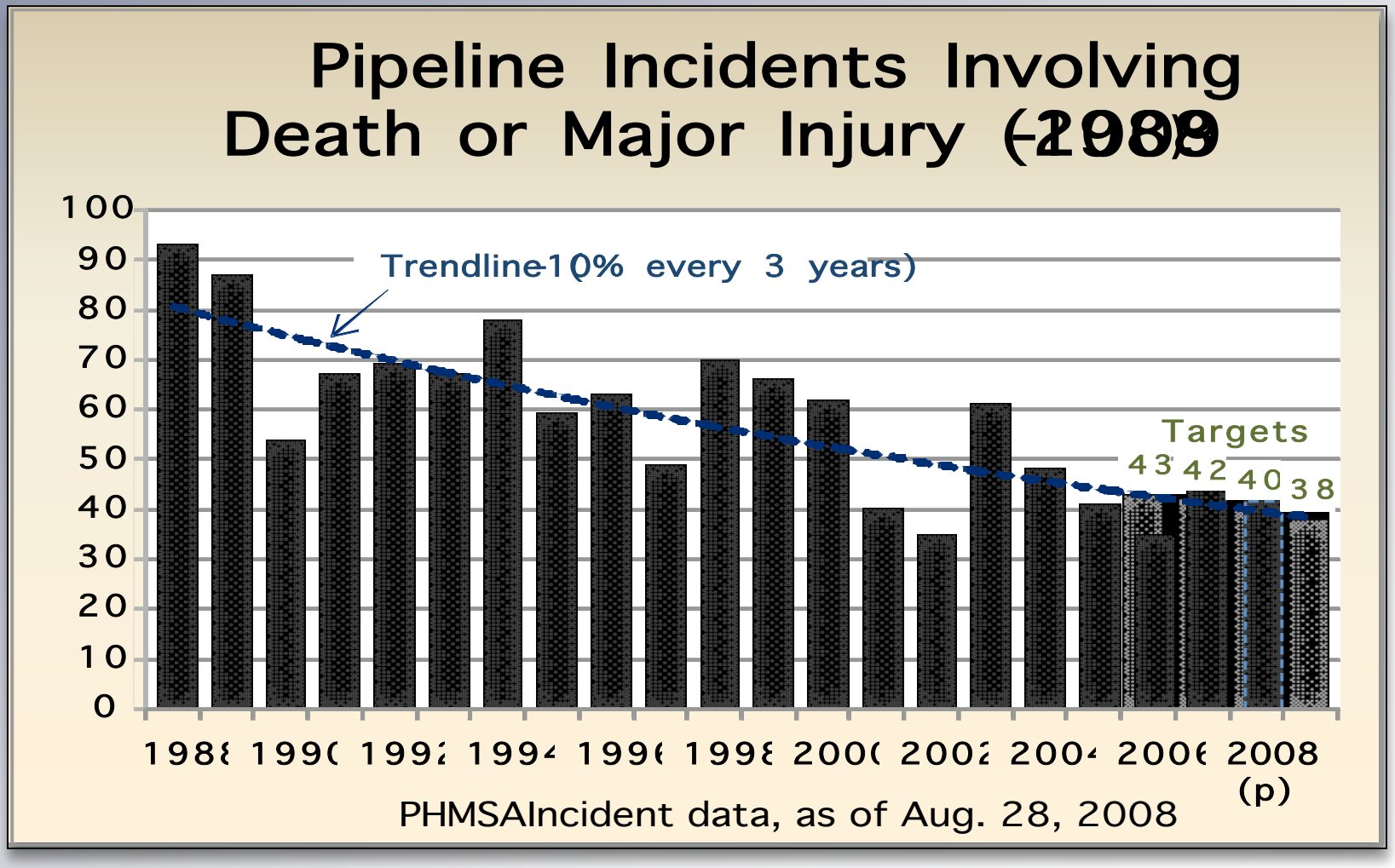
Government/Industry Pipeline R&D Forum
June 24-25, 2009, Crystal City, VA

Setting the Stage

- **The role of Energy Pipelines**
  - Essential and necessary links between production/delivery and consumption
  - Different pipes serve different functions in the supply chain and face different challenges
  - Disruptions/lack of capacity constrain supply
  - More capacity needed!

Setting the Stage: Frequency



Setting the Stage: Consequence

National Gas Distribution: Consequences Summary Statistics: 2003-2007

Year	Public Fatalities		Industry Fatalities		Public Injuries		Industry Injuries		Total Property Damage [B] [C]	Damage to Public Property [D] [B]		Damage to Industry Property [E] [B]		Value of Product Lost [B]	
2004	13	100%	0	0%	22	66%	11	33%	$32,407,600	$24,222,505	74%	$6,983,318	21%	$1,201,776	3%
2005	11	78%	3	21%	31	79%	8	20%	$536,955,458	$27,200,095	5%	$504,283,125	93%	$5,472,238	1%
2006	10	62%	6	37%	11	42%	13	50%	$20,066,461	$17,860,192	89%	$1,892,237	9%	$314,032	1%
2007	7	77%	2	22%	23	63%	13	36%	$23,434,503	$20,043,622	85%	$3,114,135	13%	$276,746	1%
Totals	41	78%	11	21%	87	64%	45	33%	$612,864,023	$89,326,415	14%	$516,272,815	84%	$7,264,793	1%

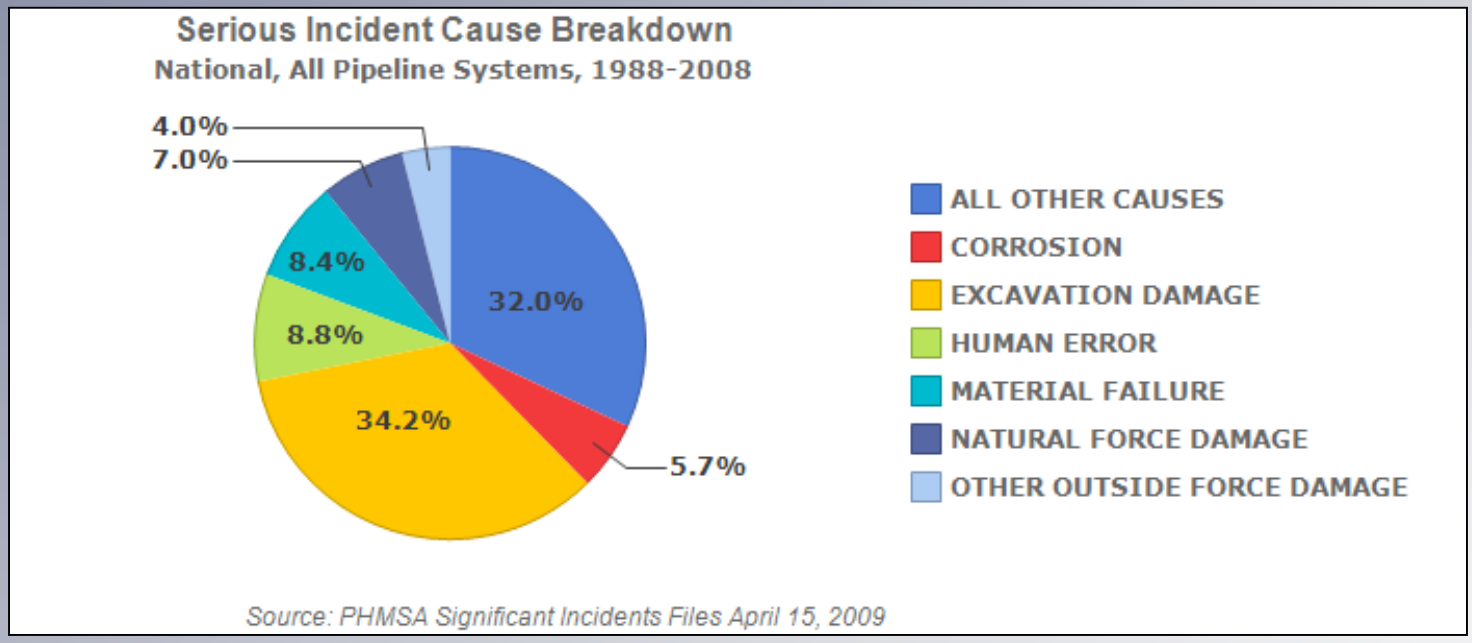
National Gas Transmission: Consequences Summary Statistics: 2003-2007

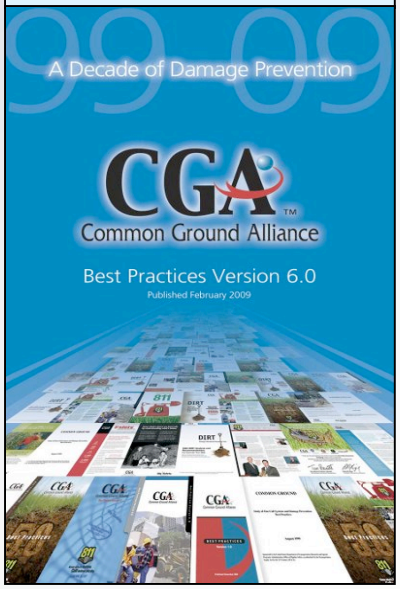
Year	Public Fatalities		Industry Fatalities		Public Injuries		Industry Injuries		Total Property Damage [B] [C]	Damage to Public Property [D] [B]		Damage to Industry Property [E] [B]		Value of Product Lost [B]	
2003	0	0%	1	100%	3	37%	5	62%	$56,232,363	$11,407,440	20%	$27,054,585	48%	$17,770,337	31%
2004	0	0%	0	0%	0	0%	2	100%	$38,262,823	$174,417	0%	$28,571,481	74%	$9,516,923	24%
2005	0	0%	0	0%	2	40%	3	60%	$237,223,169	$92,511,087	39%	$120,326,393	50%	$24,385,687	10%
2006	1	33%	2	66%	1	25%	3	75%	$38,827,402	$2,706,730	7%	$28,860,670	74%	$7,260,002	18%
2007	1	50%	1	50%	1	14%	6	85%	$54,452,580	$1,538,500	2%	$34,894,884	64%	$18,019,196	33%
Totals	2	33%	4	66%	7	26%	19	73%	$424,998,338	$108,338,176	25%	$239,708,015	56%	$76,952,147	18%

National Hazardous Liquid: Consequences Summary Statistics: 2003-2007

Year	Public Fatalities		Industry Fatalities		Public Injuries		Industry Injuries		Total Property Damage [B] [C]	Damage to Public Property [D] [B]		Damage to Industry Property [E] [B]		Value of Product Lost [B]	
2003	0	0%	0	0%	0	0%	5	100%	$54,538,762	$31,011,307	56%	$22,034,644	40%	$1,492,811	2%
2004	5	100%	0	0%	15	93%	1	6%	$159,374,542	$33,755,694	21%	$122,841,426	77%	$2,777,421	1%
2005	0	0%	2	100%	2	100%	0	0%	$165,426,524	$84,036,748	50%	$77,911,540	47%	$3,478,235	2%
2006	0	0%	0	0%	2	100%	0	0%	$62,150,187	$19,855,728	31%	$38,032,187	61%	$4,262,271	6%
2007	2	50%	2	50%	9	90%	1	10%	$50,502,629	$18,982,971	37%	$27,980,501	55%	$3,539,157	7%
Totals	7	63%	4	36%	28	80%	7	20%	$491,992,646	$187,642,449	38%	$288,800,299	58%	$15,549,896	3%

Pipeline Threats





- **There is no one-size, fits all solution to this wide ranging set of failure causes**

Steps Taken to Improve Performance

- Fortified Regulatory Standards – some of which aren't yet in effect
  - e.g., reporting, IMP, CRM, damage prevention
- Increased and Improved Regulatory Oversight/Enforcement
  - Both at the national and State levels
- Increased (though still underinvested) investments in R&D
  - Improved technology, better standards, and foundation knowledge improvements
- Improved understanding of risks and risk controls
  - e.g., SCC, excavation damage, casings, etc.
- Expanded public participation and transparency

Current Challenges

- Connecting new sources of supply with demand
  - Driving down project economics
  - While shoring up lifecycle management quality control
    - Confidence most recently shaken with construction
      - Problems encountered in materials procurement, welding, coatings, lay techniques, precommission test failures, etc.
- Economically and rigorously shoring up fitness for purpose of existing infrastructure
- Properly incentivizing all companies to "do the right thing"
  - Pipelines, utilities, excavators, locators, vendors, etc.
- Persuading communities to make smarter land use decisions near pipelines

Steps Needed to Further Improve Pipeline Transportation Performance

- Better data – improve risk-informed decisions and choices
- Better risk models – helping companies and regulators alike
  - To prioritize assessments, repairs, and maintenance alike
- Better assessment/characterization technologies
  - Especially for long seams, casings, and unpiggable pipe
- More rapid commercialization of new technolgies
- Expanded/improved maintenance – especially in facilities
- Improved confidence in science underpinning repair algorithms
- Collaboration in understanding risks on new products
  - e.g., biofuels joint project
- Increased investment in R&D – both short to mid-, as well as long-term research

Learning Much from Canada!

- **Arctic Pipeline Experience**
- **New technology deployment**
- **Welding high strength steels**
- **Strain Based Design**
- **Reliability Based Design Assessments**
- **Alternative Integrity Verification**

Technical Challenges Remain

- **Gas Integrity Management**
  - Baseline Assessments 2012
  - Lack of technology for unpiggable systems
  - Long-term cased crossing

Failure of Cased Crossing Under Highway

Technical Challenges Remain

- **Corrosion**
  - External
  - Internal
  - Stress Corrosion Cracking
  - Microbial Induced

External Corrosion

Technical Challenges Remain

- **New Construction**
  - Materials
  - Welding
  - Coatings
  - Installation
  - Applying lessons learned:
    - Preventing Damage
    - Protecting Communities

Technical Challenges Remain

- **Safely Transporting Alternative Fuels**
  - Ethanol – SCC, elastomers, oxygen monitoring
  - Biodiesel – Inhibitor performance
  - Biogas – MIC and Internal corrosion
  - Hydrogen Economy – Materials and cracking
- **Climate Change Issues**
  - CO2 Pipelines – Corrosion, safe blow down, protecting communities

Future is Bright!

- **Strong coalitions/partnerships formed**
- **Data and science are driving more decisions – politics are driving fewer**
- **Many new or improved standards/best practices now available**
- **Infrastructure making adjustments to handle alternative fuels**
- **Research facilitating the desired impacts we are striving for!**

Thank You!