

S&P Global

Engineering Solutions

AI-powered Cognitive Search for Information in Nuclear Knowledge Management

Thomas Devaraj – S&P Global

October 2022 – Toronto, Canada



Addressing Nuclear Knowledge Management challenges



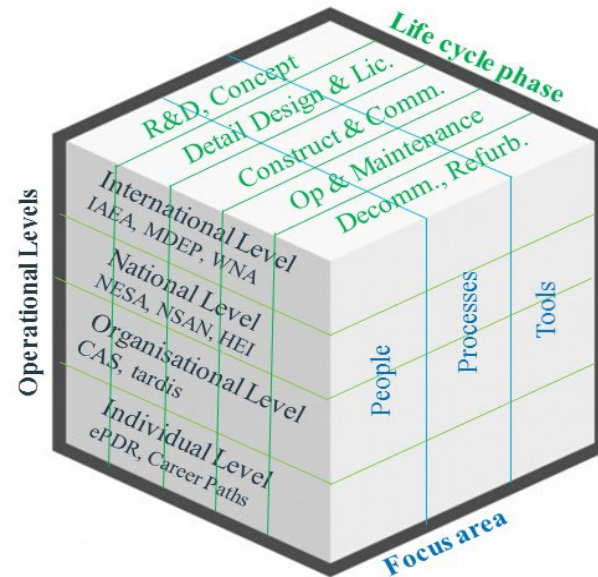
There is a need to maintain & leverage this knowledge over the Life-cycle (80 to 110 years)

Enablers

- People
- Processes
- Technology
- Governance
- Culture

Activities

- Acquiring
- Applying
- Retaining
- Handling Outdated Knowledge



Organisations may have to manage knowledge flowing through $5 \times 3 \times 4 = 60$ areas over 100 years

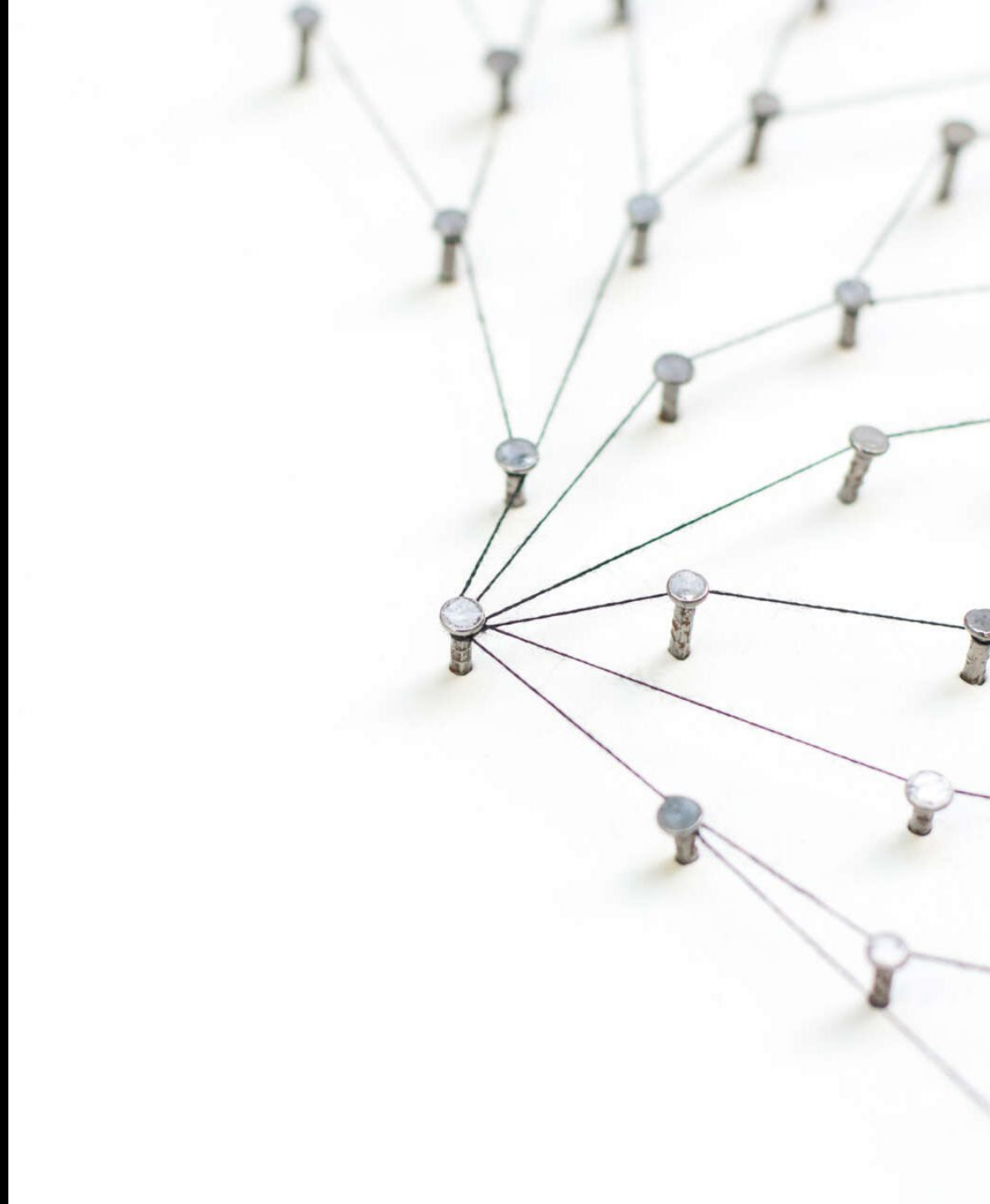
Can this knowledge be leveraged effectively over the entire life-cycle?

The Challenge

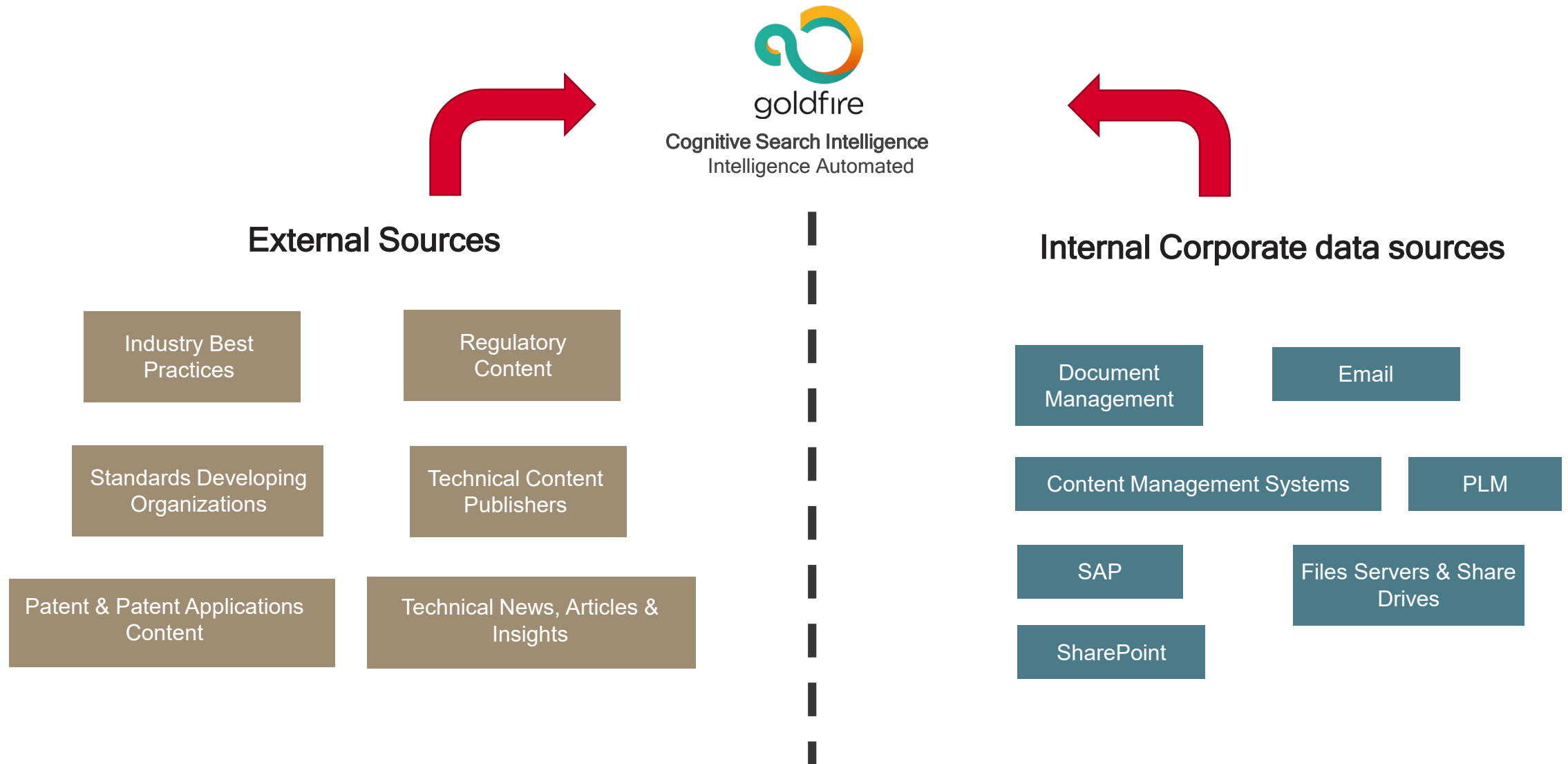
Millions of data assets

- Structured
- Semi-structured
- Unstructured

Including, but not limited to:

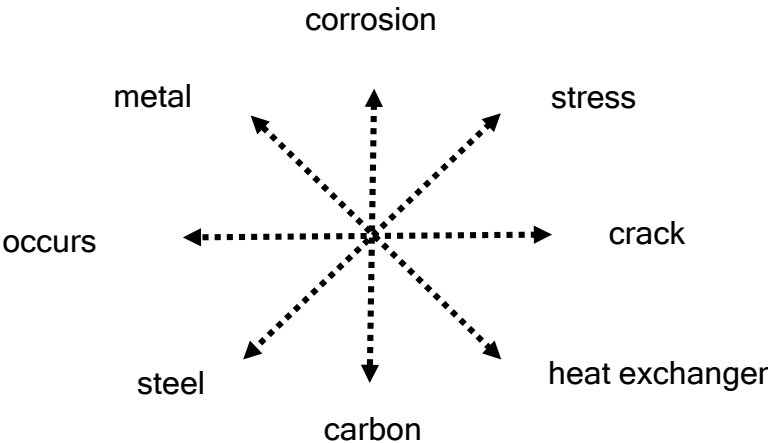
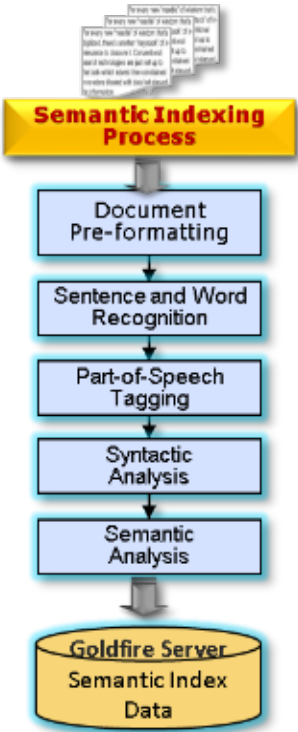


Enabling effective research through a single platform

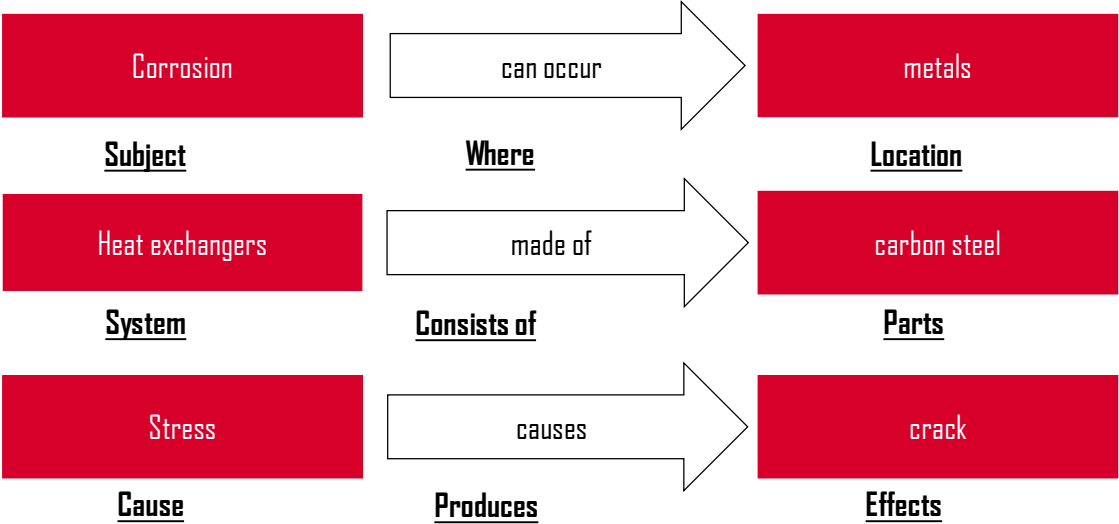


Goldfire applies AI, ML & Natural Language Processing to all documents

Corrosion can occur in metals which are placed under too much **stress** and the material begins to **crack**. Heat Exchangers are prone to corrosion as they are **made of metals** like carbon-steel.



Conventional search technologies typically **extract keywords** but do not know the underlying meanings.



Goldfire Cognitive Search **extracts underlying meaning**, so you get back precisely **relevant answers**.

NLP technology helps to answer questions

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EN how to prevent intergranular stress corrosion cracking

Advanced



Prevent

☒ SYNONYMS & ONTOLOGY 

Control of halogen elements in materials (e.g. pipe insulation) in contact with stainless steel components should be **ensured** by **design** in order to **prevent** intergranular stress corrosion cracking (IGSCC).

IAEA NS-G-1.2 Safety Assessment & Verification for Nuclear Power Plants

Avoid

Nitrogen-16 production is **increased by routine hydrogen gas injection** into the FW in an effort to prevent intergranular stress corrosion cracking of reactor internals.

OSTI.gov Articles

Prevent

The **presence of** some **delta ferrite** (typically 5% or more) substantially increases resistance to intergranular stress corrosion cracking.

NRC Articles

Increase resistance to

From the previous discussion, it is apparent that intergranular SCC of Ni-Cr-Fe alloys in the presence of metastable sulfur oxyanions can be avoided by **using prolonged heat treatments** (i.e., 15 h at 700 °C, or 1290 °F, for alloy 600) that replenish the chromium--deplete

ASM eBooks

Avoid

Zinc oxide is also **used in** the **cooling water of** some **nuclear reactors** to inhibit intergranular stress corrosion cracking of pipes and internal reactor parts.

U.S. Granted Patents

Inhibit

Quickly surface 360° view of related topics

Select where to search: ☒ S&P Global Content ☒ Articles ☒ Patents ☐ Corporate

☐ My Data


EN Pump



Advanced



Set Query Alert

☒ SYNONYMS & ONTOLOGY 

<div>Definitions</div> <div><div><div><div></div></div><div>-</div></div></div> <div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div></div> <div>More</div>	<div>Properties</div> <div><div><div><div></div></div><div>-</div></div></div> <div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div></div> <div>More</div>	<div>More Specific</div> <div><div><div><div></div></div><div>-</div></div></div> <div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div></div> <div>More</div>	<div>Concepts</div> <div><div><div><div></div></div><div>-</div></div></div> <div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div></div> <div>More</div>	<div>Locations</div> <div><div><div><div></div></div><div>-</div></div></div> <div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div></div> <div>More</div>	<div>Materials</div> <div><div><div><div></div></div><div>-</div></div></div> <div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div></div> <div>More</div>	<div>Made Up Of</div> <div><div><div><div></div></div><div>-</div></div></div> <div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div></div> <div>More</div>	<div>Part Of</div> <div><div><div><div></div></div><div>-</div></div></div> <div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div><div><div><div></div></div><div></div></div></div> <div>More</div>
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AI & Machine learning automate the extraction of Metadata

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EN ▼

Inter-granular stress corrosion cracking

Advanced



Set Query Alert

☒ SYNONYMS & ONTOLOGY 

▼ Publication

- ☐ Select all from below
- | | |
|---|-------|
| <input type="checkbox"/> Materials and Corrosion | 1,125 |
| <input type="checkbox"/> Journal of the American Ceramic Society | 388 |
| <input type="checkbox"/> Corrosion | 232 |
| <input type="checkbox"/> Metall Mater Trans A | 228 |
| <input type="checkbox"/> J. of Materi Eng and Perform | 210 |
| <input type="checkbox"/> Fatigue & Fracture of Engineering Materials & Structures | 199 |
| <input type="checkbox"/> SAE Technical Paper | 190 |
| <input type="checkbox"/> IOP Conference Series: Materials Science and Engineering | 145 |
| <input type="checkbox"/> MRS Online Proceedings Library | 135 |
| <input type="checkbox"/> Journal of Materials Research | 129 |
- [More...](#)

▼ Topics

- ☐ Select all from below
- | | |
|---|-------|
| <input type="checkbox"/> alloys | 9,223 |
| <input type="checkbox"/> corrosion | 7,042 |
| <input type="checkbox"/> steel | 6,549 |
| <input type="checkbox"/> corrosion cracking | 5,375 |
| <input type="checkbox"/> grain boundaries | 4,664 |
| <input type="checkbox"/> corrosion resistance | 4,222 |
| <input type="checkbox"/> heat treatment | 4,005 |
| <input type="checkbox"/> specimen | 3,904 |
| <input type="checkbox"/> cracks | 3,683 |
| <input type="checkbox"/> welds | 3,418 |
- [More...](#)

▼ Referenced Parameters

- ☐ Select all from below
- | | |
|--------------------------------------|-------|
| <input type="checkbox"/> sizes | 3,915 |
| <input type="checkbox"/> Temperature | 3,857 |
| <input type="checkbox"/> thickness | 3,725 |
| <input type="checkbox"/> Density | 3,682 |
| <input type="checkbox"/> pressure | 3,657 |
| <input type="checkbox"/> strength | 3,558 |
| <input type="checkbox"/> Length | 3,543 |
| <input type="checkbox"/> shape | 3,512 |
| <input type="checkbox"/> depth | 3,495 |
| <input type="checkbox"/> diameter | 3,463 |
- [More...](#)

▼ Content Classes

- | | | |
|---|-------|---|
| <input type="checkbox"/> Codes & Standards | 153 | > |
| <input type="checkbox"/> Engineering Books | 2,256 | > |
| <input type="checkbox"/> Patents & Applications | 45 | > |
| <input type="checkbox"/> Articles & Journals | 1,585 | > |
| <input type="checkbox"/> Corporate | 5 | > |
- [Distribution by knowledge bases...](#)

▼ Referenced Organizations

- ☐ Select all from below
- | | |
|---|--------|
| <input type="checkbox"/> ASME | 14,625 |
| <input type="checkbox"/> ASTM | 13,539 |
| <input type="checkbox"/> NRC | 10,556 |
| <input type="checkbox"/> McGraw- Hill | 7,102 |
| <input type="checkbox"/> ISO | 5,933 |
| <input type="checkbox"/> U.S. Nuclear Regulatory Commission | 5,902 |
| <input type="checkbox"/> DOE | 5,898 |
| <input type="checkbox"/> Nuclear Regulatory Commission | 5,602 |
| <input type="checkbox"/> SCC | 5,567 |
| <input type="checkbox"/> United States Government | 5,296 |
- [More...](#)

▼ Referenced Chemical Substances

- ☐ Select all from below
- | | |
|--|-------|
| <input type="checkbox"/> carbon | 3,199 |
| <input type="checkbox"/> steel | 3,180 |
| <input type="checkbox"/> Aluminum | 3,084 |
| <input type="checkbox"/> oxygen | 3,055 |
| <input type="checkbox"/> iron | 3,042 |
| <input type="checkbox"/> copper | 2,774 |
| <input type="checkbox"/> hydrogen | 2,754 |
| <input type="checkbox"/> nitrogen | 2,624 |
| <input type="checkbox"/> nickel | 2,553 |
| <input type="checkbox"/> stainless steel | 2,524 |
- [More...](#)


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EN Inter-granular stress corrosion cracking

Advanced





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Causes	☆ ⚙ -
localized deformation	(23) ▲
sensitization	(22)
inadvertent introduction o...	(22)
ingress of demineralizer r...	(19)
ingredient	(18)
chloride	(16)
hydrogen	(12)
reduction in chromium con...	(9)
residual stress	(8)
oxygen	(6) ▼
Less	

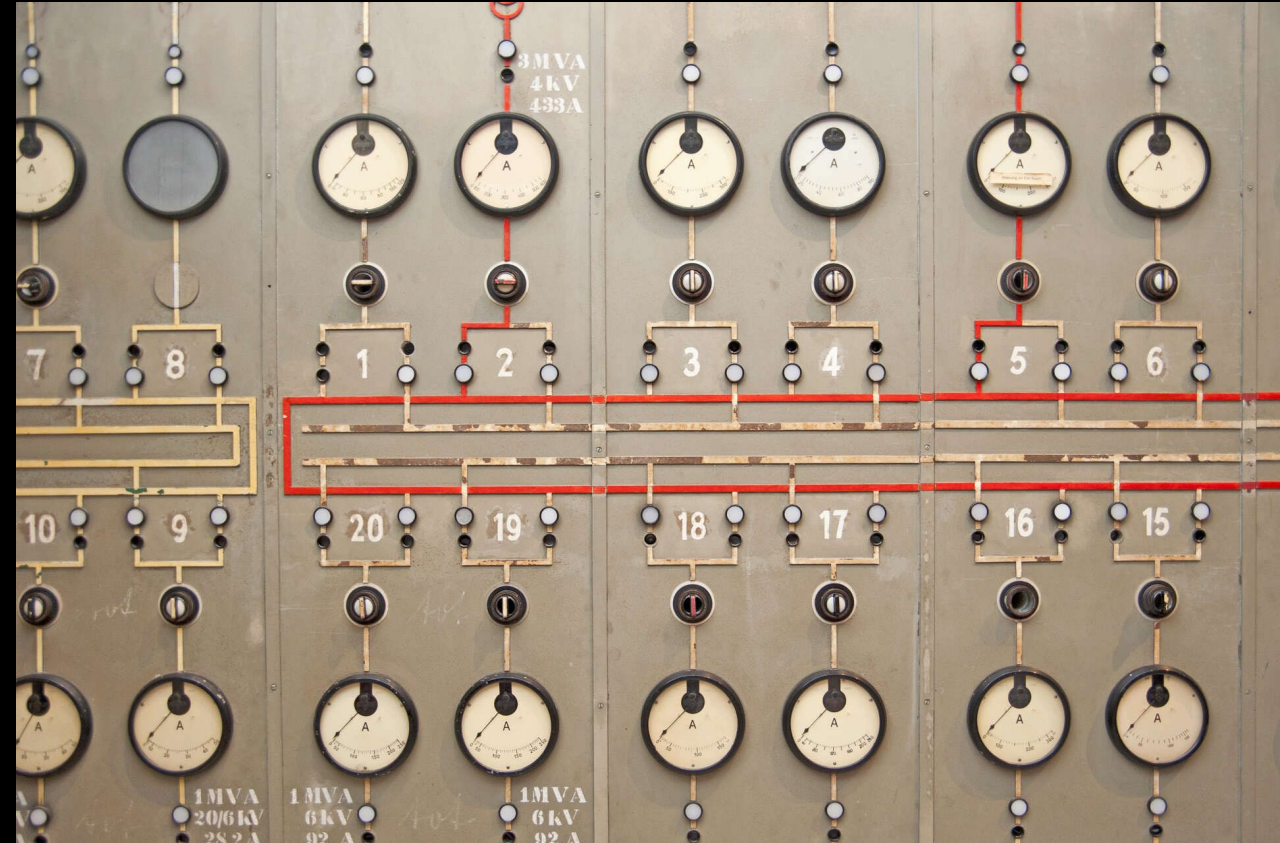
Effects	☆ ⚙ -
tight crack	(22) ▲
flaw	(20)
management of cracking	(20)
management of crack initi...	(19)
leak	(16)
defective steam generator...	(13)
cracking of program	(11)
leakage	(11)
degradation	(11)
severe damage	(8) ▼
Less	

Preventions	☆ ⚙ -
requirement of vessel ma...	(46) ▲
sensitization of alloys in ...	(12)
Hydrogen Water Chemist...	(11)
hydrogen water chemistry	(11)
specification of process r...	(10)
specification of material i...	(10)
HWC	(9)
presence of delta ferrite	(8)
improvement of environment	(7)
increase of nitrogen-16 pr...	(7) ▼
Less	

-  **Regulatory Guide 3.37, Guidance for Avoiding Intergranular Corrosion and Stress Corrosion in Austenitic Stainless Steel Components of Fuel Reprocessing Plants**
PUBLISHER: NRC/RES
PUBLICATION DATE: 9/30/1975
TOPICS: intergranular corrosion and stress corrosion, stress corrosion, stress corrosion cracking
KNOWLEDGE BASE: NRC Articles
GUIDANCE FOR AVOIDING INTERGRANULAR CORROSION AND STRESS CORROSION IN AUSTENITIC STAINLESS STEEL COMPONENTS OF FUEL REPROCESSING PLANTS. [More \(19\)](#)
[Save](#) [Summary](#)
-  **US-20090010377 A1 INHIBITOR OF CORROSION AND STRESS CORROSION CRACKING CONTAINING NICKEL BORIDE (NiB) IN THE SECONDARY SIDE OF STEAM GENERATOR TUBES IN A NUCLEAR POWER PLANT AND INHIBITING METHOD USING THE SAME**
PUBLICATION DATE: 1/8/2009
TOPICS: corrosion and stress corrosion cracking, stress corrosion cracking, nickel boride, corrosion c racking ...
KNOWLEDGE BASE: U.S. Patent Applications
A method of inhibiting corrosion and stress corrosion cracking of a steam generator tube in a nuclear power plant, includes the steps of providing a nuclear power plant having a secondary side feedwater system including a secondary side feedwater of a steam generator tube; and supplying nickel boride to said secondary side feedwater to inhibit corrosion and stress corrosion cracking. [More \(49\)](#)
[Save](#) [Summary](#) [2 Similar Documents](#)

Allows for effective problem understanding and resolution

NLP/AI Powered Knowledge Enablement: Nuclear Projects



Extracting knowledge from Archives

Problem

Huge volumes of multiformat high value information that included technical reports from various legacy nuclear projects dating back decades

- Recurring **annual storage costs** + additional **retrieval costs**
- **Significant time & effort** to find the answers & responses
- Potential **loss of expertise & knowledge**
- Unnecessary rework

Solution

S&P Global's **Goldfire solution** powered with leading NLP & AI capabilities

- **Physical documents stored in archives were retrieved** and subsequently scanned & digitized
- **Full text of digitized documents** were indexed using Goldfire cognitive & AI making them **instantly discoverable**.
- **Named Entities & attributes** were **automatically extracted** from full text

Results

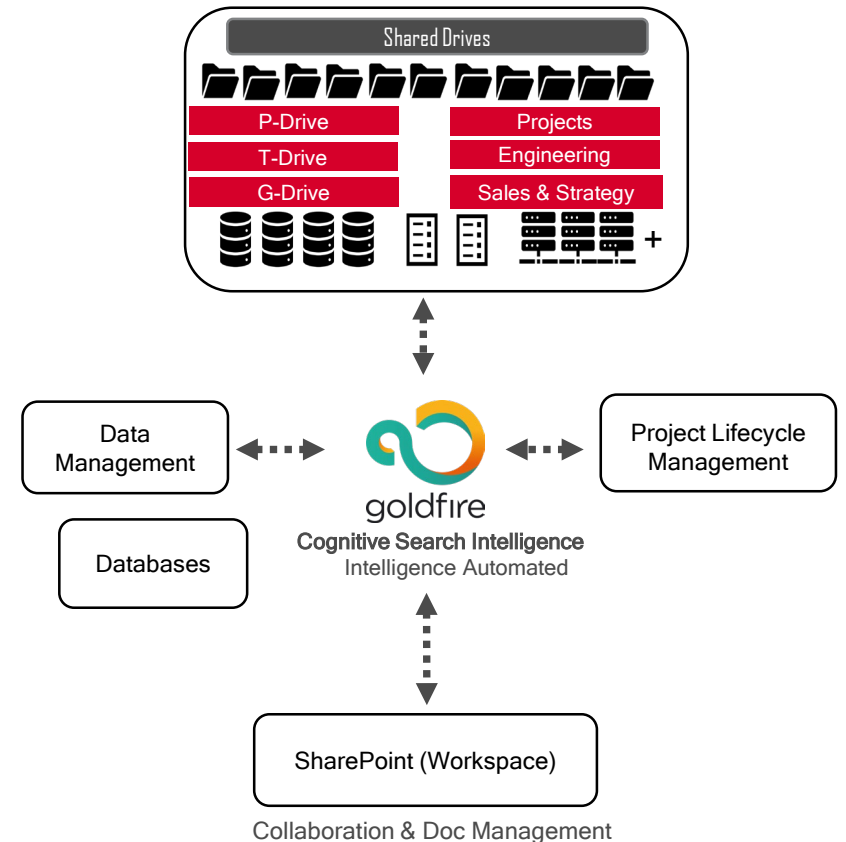
S&P Global's Goldfire solution allowed critical **answers to be surfaced** from **decades old** archives in a **matter of minutes**.

Further use cases to support knowledge driven processes

- Production of safety cases
- Equipment qualification support
- Technology Horizon Scanning during bid & tender process

Conclusion: Benefits of AI Powered Research

1. Single integrated search environment that finds **answers, insights, documents & people** in seconds
2. Engineers save time & find the right solutions, make the **right** decisions with increasing **confidence**
3. Legacy projects & products can continue to be supported limiting the impact of **brain-drain** as experience retires.
4. New employees & project members integrate & become productive/contribute **faster**
5. **Expertise** of the past can be leveraged for the solutions of the future or decommissioning
6. Knowledge-driven processes (e.g., Bid & Tender responses, Technology Horizon Scanning, Engineering change, Safety Case etc.) are effectively supported with the right information **on demand**.



Data is never moved; it remains in its current location

Thank you.

Follow up contacts

Thomas.Devaraj@spglobal.com

or

Andy.Mayer@spglobal.com