CAP Automation and Informed Inspection Preparation Project - Update

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Agenda

- Project Objectives

- Progress

  - Screening and Automation

  - Inspection Preparation

- Keywords and Trends

  - Topics relevant to P&IR

  - Diverse techniques/approaches

- Next Steps

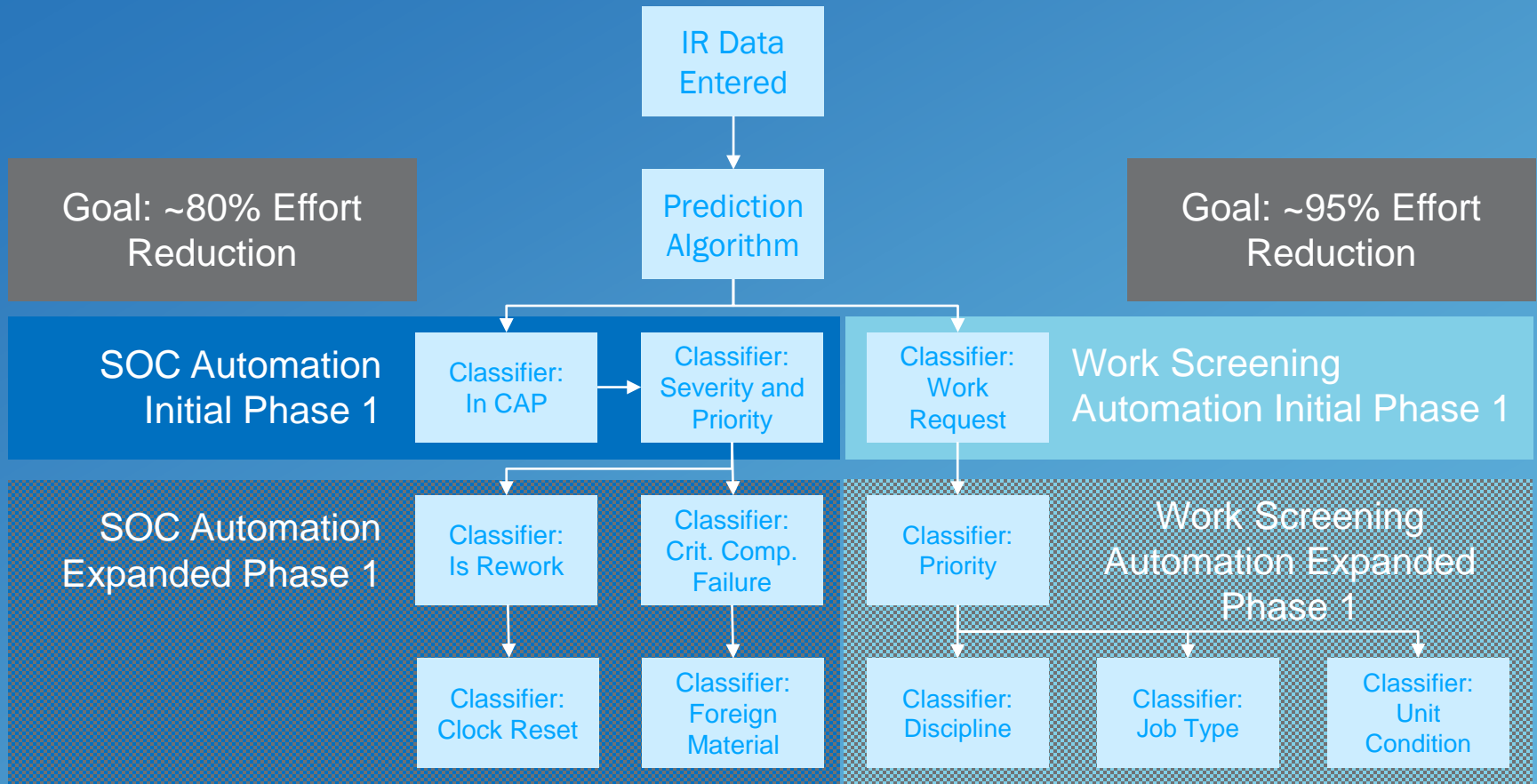- Closing Remarks

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Project Objectives

- Explore artificial intelligence and machine learning techniques to improve use of plant information

- Leverage data science technologies and methods

- Identify opportunities to improve utility processes
  - Incident Report Processing
  - Station Ownership Committee
  - Work Week Planning
  - NRC inspection preparation

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Project Focus on CAP Data

- Cornerstone of Reactor Oversight Process (ROP)

- Streamlining and strengthening the CAP through use of AI/ML is expected to:
  - Improve consistency in processing, incoming IRs
  - Automate collection of data for inspection preparation
  - Find hidden trends and insights in existing CAP data

- Important Condition reports (CRs) requiring attention

- Software provides a textual comment explaining *why* the decision was made (enhances explainability)

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Incident Report Screening Automation Process

IR Data Entered

Prediction Algorithm

Goal: ~80% Effort Reduction

Goal: ~95% Effort Reduction

SOC Automation Initial Phase 1

Classifier: In CAP

Classifier: Severity and Priority

Classifier: Work Request

Work Screening Automation Initial Phase 1

SOC Automation Expanded Phase 1

Classifier: Is Rework

Classifier: Crit. Comp. Failure

Classifier: Priority

Work Screening Automation Expanded Phase 1

Classifier: Clock Reset

Classifier: Foreign Material

Classifier: Discipline

Classifier: Job Type

Classifier: Unit Condition

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Automation Progress

- CAP and New Work Screening stakeholder input

- Areas of automation to reach effort reduction
    - Critical component failures
    - Nondiscretionary clock rests
    - Rework

- Completed models for CR/NCAP items and if they represent a significant condition (SCAQ)

- Develop additional models and results page (i.e., user interface) built into NUCAP 2.0
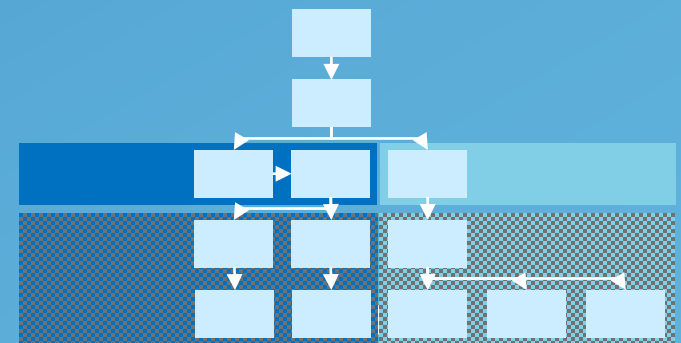
CAP Statistics (2017 - 2021)

The "significant" conditions that warrant increased attention, investigation and corrective actions comprise about 1% of all CR's generated

All CRs including NCAP

	Severity 1	Severity 2	Severity 3	Severity 4	Severity 5
Priority A	3	66	25	1	0
Priority B	0	123	372	45	0
Priority D	2	50	3,569	403,231	1,359

CAP (i.e., CAQ)

	Severity 1	Severity 2	Severity 3	Severity 4	Severity 5
Priority A	3	66	25	1	0
Priority B	0	123	371	41	0
Priority D	0	49	3,528	300,364	476

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Informed Inspection Preparation

- Leverage insights from CAP automation and apply these to the identification of relevant inspection trends

- Enhance internal assessments and inform inspections
  - Streamline information sharing through an inspection data portal
  - Develop data-driven metrics to support inspection outcomes
  - Inform these processes though automation

- Develop tools to automate/identify risk contributors
  - Identify and highlight risk-significant information using PRA insights
  - Components and/or operator actions
  - Programmatic and predictive trends

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Topics Relevant to P&IR (from IP 71152)

- Negative trends in human/equipment performance

- Cited or non-cited violations

- Significant conditions (SCAQ)

- ROP cross-cutting themes

- Risk significant issues and trends

- Long-standing degraded conditions

- Reductions in design or operational margin

- Repetitive work orders and equipment failures

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Keyword/Topics

Topic	Word 0	Word 1	Word 2	Word 3	Word 4	Word 5	Word 6	Word 7	Word 8	Word 9	Word 10
Alarm	alarm	received	annunciator	reset	alarm received	clear	cleared	unexpected	local	trouble	alarm cleared
Badging	access	lost badge	badge	protected area	lanyard	badging	badge control	oca	visitor	escort	security badge
Battery	battery	voltage	cell	ground	vdc	battery charger	load	amp	charger	volt	battery room
Bolting	bolt	cap	nut	torque	stud	bolting	flange	gasket	ring	hole	fit
Boric acid	boric acid	valve	leak	leakage	boric acid leak	system pressure boundary	pressure boundary	packing	safety related ssc	boric acid corrosion	
Breakers	breaker	mcc	disconnect	cubicle	circuit breaker	bucket	panel	circuit	bkr	trip	tripped
Cable	cable	wire	conduit	box	tb	connection	electrical	wiring	cable tray	ground	connector
Calculation	calculation	analysis	engineering	usar	calc	input	helb	design basis	assumed	assumption	design
Calibration	calibration	instrument	tolerance	setpoint	cal	calibrated	icpm	te	setpoints	instrumentation	found tolerance
Cause evaluation	action	assignment	cause evaluation	apparent cause	grading	assigned	ace	rce	capr	parb	root cause
Chemical control	material	storage	stored	container	chemical	box	bottle	label	cabinet	drum	labelled
Chemistry	sample	chemistry	result	analysis	sampling	lab	ppm	elevated	chem	concentration	ppb
Clearance order	clearance order	isolation	tag	checklist	isolated	clearance	restoration	tagging	tagged	isolate	boundary
Communication equipment	communication	notification	call	phone	radio	called	page	pager	speaker	telephone	cell phone
Configuration management	drawing	field	discrepancy	id	label	labelled	match	shown	print	configuration	labelling
Containment	reactor coolant system	reactor coolant pump	containment	leakage	seal	rc	vault	mode	dw	gpm	reactor coolant pump motor

Hypothetical CR Text	t1	w1	t2	w2	t3	w3	t4	w4	t5	w5
During performance of 'Site Evacuation Alarm Test', the evacuation siren in the EDG Bay did not sound. The evacuation beacon was previously issued under different IRs. Equipment condition appears to be degrading. Test was completed UNSAT due to EDG beacon not lighting.	Emergency planning	19.2	Communication equipment	11.7	Emergency drills	1.5	Diesel generator	1.4	Rad Con instrumentation	0.9

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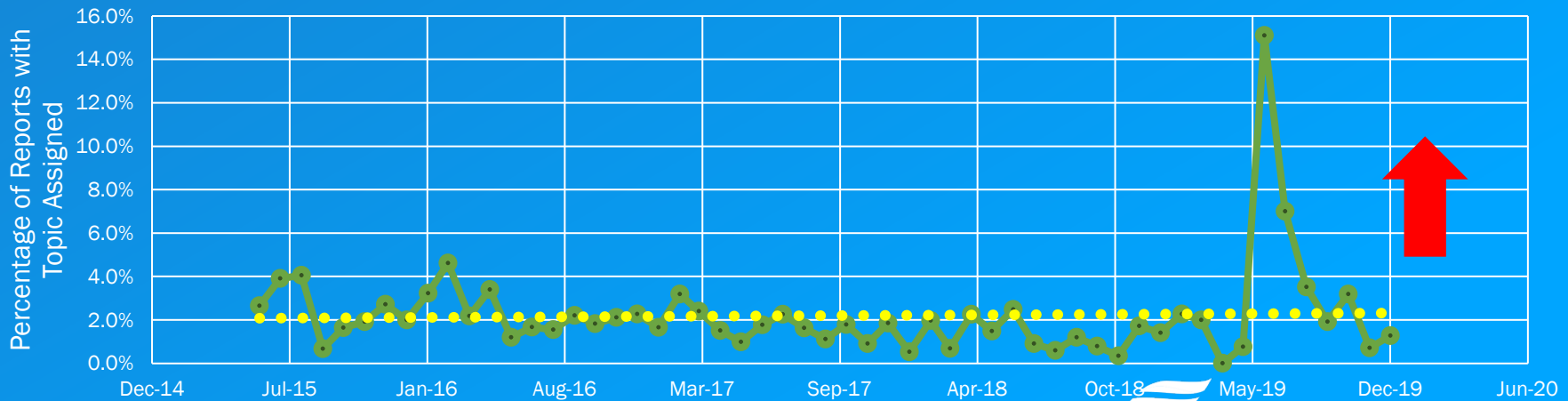# Trending

Data-driven keywords with industry data to standardize trending

NRC AI/ML Workshop
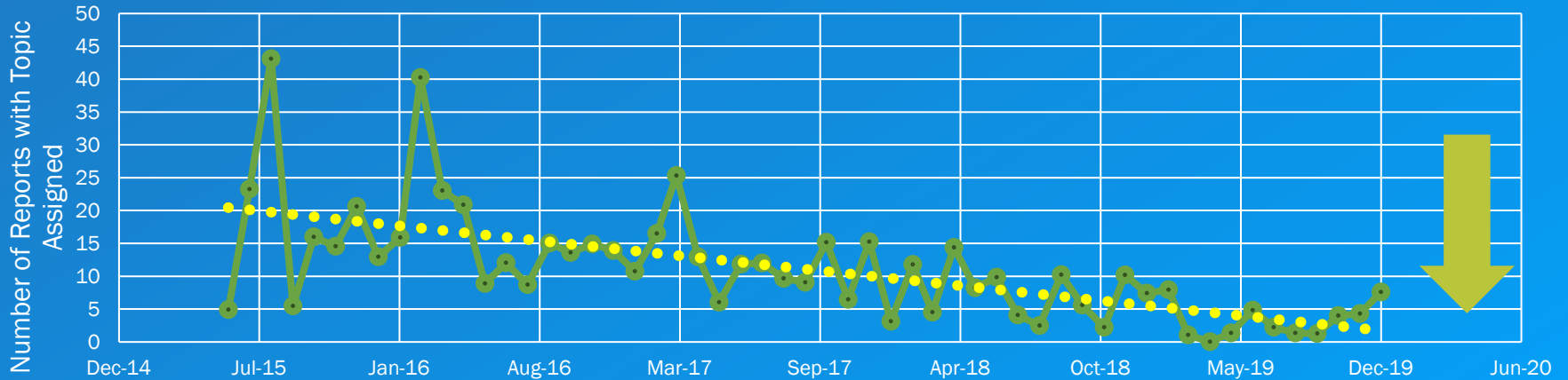
Diverse AI/ML Techniques and Approaches

- JH uses a "classifier" algorithm (*CAP Analyzer*) with supervised learning to predict rare events

- INL uses a combination of supervised (*Cortex*) and unsupervised learning (Latent Dirichlet allocation) to create trends

- Integrate and leverage both approaches

- Allows independent validation

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Working ... Next steps

Ongoing

- Insights from plant subject matter experts

- Collaboration with Xcel Energy

- Compare Exelon dataset with other utility results and optimize keywords (e.g., specificity)

Future

- Pilot CAP automation – 1st Q 2022

- Explore metrics pertinent to P&IR inspection (and expand to other inspection areas) – 2nd Q 2022

- Deploy open-source tools for broad industry use

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Concluding Remarks

- AI/ML techniques have the potential to strengthen the Corrective Action Program

- Overarching goal is to improve Exelon internal governance and oversight

- Stakeholder engagement and input is critical
  "Designers must proactively address their innovation so individuals should decide on long-term use of their product"

- Integration with NRC and industry presents the opportunity for a powerful outcome

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Questions?

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