

Small Data Tagging using the Nestor tagging tool

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Outline

1. Manual Cleaning
2. Rules-Based Method
3. Manual Tagging
4. Ranked Tagging

Manual Cleaning

Description	Resolution	Cause	Effect	Solutions
<p>“Hyd leak at saw attachment”</p>	<p>“Replaced seal in saw attachment but still leaking – Reapirs pending with ML”</p>			
<p>“HP coolant pressure at 75 psi”</p>	<p>“Bad Gauge / Low pressure lines cleaned ou”</p>			
<p>“Major hydraulic leak at Sp#6 horseshoe”</p>	<p>“Repaired horseshoe seals”</p>			
<p>“Clamping spool guard broken”</p>	<p>“Replaced – Operator could have done this!”</p>			

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<p>“Hyd leak at saw attachment”</p>	<p>“Replaced seal in saw attachment but still leaking – Reapirs pending with ML”</p>		<p>Hydraulic Leak at saw attachment</p>	<p>Replaced Seal; Repaired</p>
<p>“HP coolant pressure at 75 psi”</p>	<p>“Bad Gauge / Low pressure lines cleaned ou”</p>	<p>Bad Gauge</p>	<p>Low Coolant</p>	<p>Cleaned Out Low Pressure Lines</p>
<p>“Major hydraulic leak at Sp#6 horseshoe”</p>	<p>“Repaired horseshoe seals”</p>		<p>Major Hydraulic Leak at SP#6 Horseshoe</p>	<p>Repaired Horseshoe seals</p>
<p>“Clamping spool guard broken”</p>	<p>“Replaced – Operator could have done this!”</p>	<p>Operator error</p>	<p>Broken Clamping Spool Guard</p>	<p>Replaced Clamping Spool Guard</p>

Manual Cleaning

Description	Resolution	Cause	Effect	Solutions
"Hyd leak at saw attachment"	"Replaced seal in saw attachment but still..."		Hydraulic Leak at saw	Replaced Seal; Repaired
"HP coolant pressure at 75 psi"	<h1>12 hours for 800 MWOs</h1>			Cleaned Out Low Pressure Lines
"Major hydraulic leak at Sp#6 horseshoe"				Repaired Horseshoe seals
"Clamping spool guard broken"	"Replaced – Operator could have done this!"	Operator error	Broken Clamping Spool Guard	Replaced Clamping Spool Guard

Rules-Based Method

Description

Resolution

“Hyd leak at saw attachment”

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Rule 1: If hyd -> **Major System** = hydraulic

Rules-Based Method

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Rule 1: If hyd -> **Major System** = hydraulic

Rule 2: If hydraulic -> **Major System** = hydraulic

Rules-Based Method

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<p>“HP coolant pressure at 75 psi”</p>	<p>“Bad Gauge / Low pressure lines cleaned ou”</p>
<p>“Major hydraulic leak at Sp#6 horseshoe”</p>	<p>“Repaired horseshoe seals”</p>
<p>“Clamping spool guard broken”</p>	<p>“Replaced – Operator could have done this!”</p>

Rule 1: If hyd -> **Major System** = hydraulic

Rule 2: If hydraulic -> **Major System** = hydraulic

Rule 3: If HP and pressure > 50 psi -> **Problem** = low pressure

Rules-Based Method

Description	Resolution	Major System	Problem(s)	Solution(s)	Rule(s)
<p>“Hyd leak at saw attachment”</p>	<p>“Replaced seal in saw attachment but still leaking – Reapirs pending with ML”</p>	<p>Hydraulic</p>			<p>Rule 1</p>
<p>“HP coolant pressure at 75 psi”</p>	<p>“Bad Gauge / Low pressure lines cleaned ou”</p>				
<p>“Major hydraulic leak at Sp#6 horseshoe”</p>	<p>“Repaired horseshoe seals”</p>				
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<p>“HP coolant pressure at 75 psi”</p>	<p>“Bad Gauge / Low pressure lines cleaned ou”</p>				
<p>“Major hydraulic leak at Sp#6 horseshoe”</p>	<p>“Repaired horseshoe seals”</p>	<p>Hydraulic</p>			<p>Rule 2</p>
<p>“Clamping spool guard broken”</p>	<p>“Replaced – Operator could have done this!”</p>				

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<p>“Hyd leak at saw attachment”</p>	<p>“Replaced seal in saw attachment but still leaking – Reapirs pending with ML”</p>	<p>Hydraulic</p>			<p>Rule 1</p>
<p>“HP coolant pressure at 75 psi”</p>	<p>“Bad Gauge / Low pressure lines cleaned ou”</p>		<p>Low Pressure</p>		<p>Rule 3</p>
<p>“Major hydraulic leak at Sp#6 horseshoe”</p>	<p>“Repaired horseshoe seals”</p>	<p>Hydraulic</p>			<p>Rule 2</p>
<p>“Clamping spool guard broken”</p>	<p>“Replaced – Operator could have done this!”</p>				

Rules-Based Method

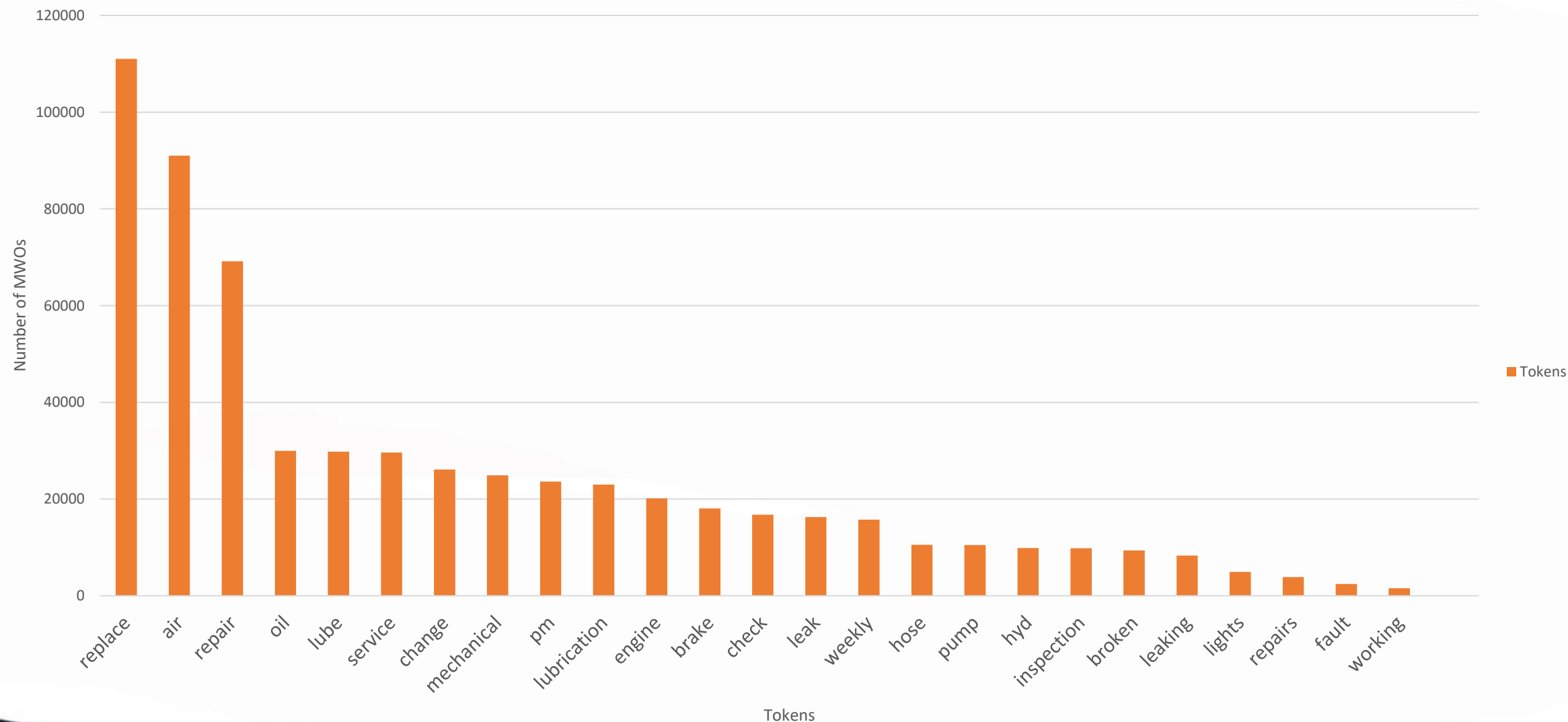
Description	Resolution	Major System	Problem(s)	Solution(s)	Rule(s)
“Hyd leak at saw attachment”	“Replaced seal in saw attachment but still leaking – Reapirs pending with ML”	Hydraulic; saw; seal	Hydraulic Leak	Replaced seal	Rule 1_4_5
“HP coolant pressure at 75 psi”	“Bad Gauge / Low pressure lines cleaned ou”	High Pressure Line; Low Pressure Line	Low Pressure; Broken Gauge	Cleaned Out Low Pressure	Rule 3_6_7_8
“Major hydraulic leak at Sp#6 horseshoe”	“Repaired horseshoe seals”	Hydraulic; seal	Hydraulic leak	Repaired seal	Rule 2_4_9
“Clamping spool guard broken”	“Replaced – Operator could have done this!”	Clamp	Clamp broken	Replaced clamp	Rule 10_11_12

Rules-Based Method

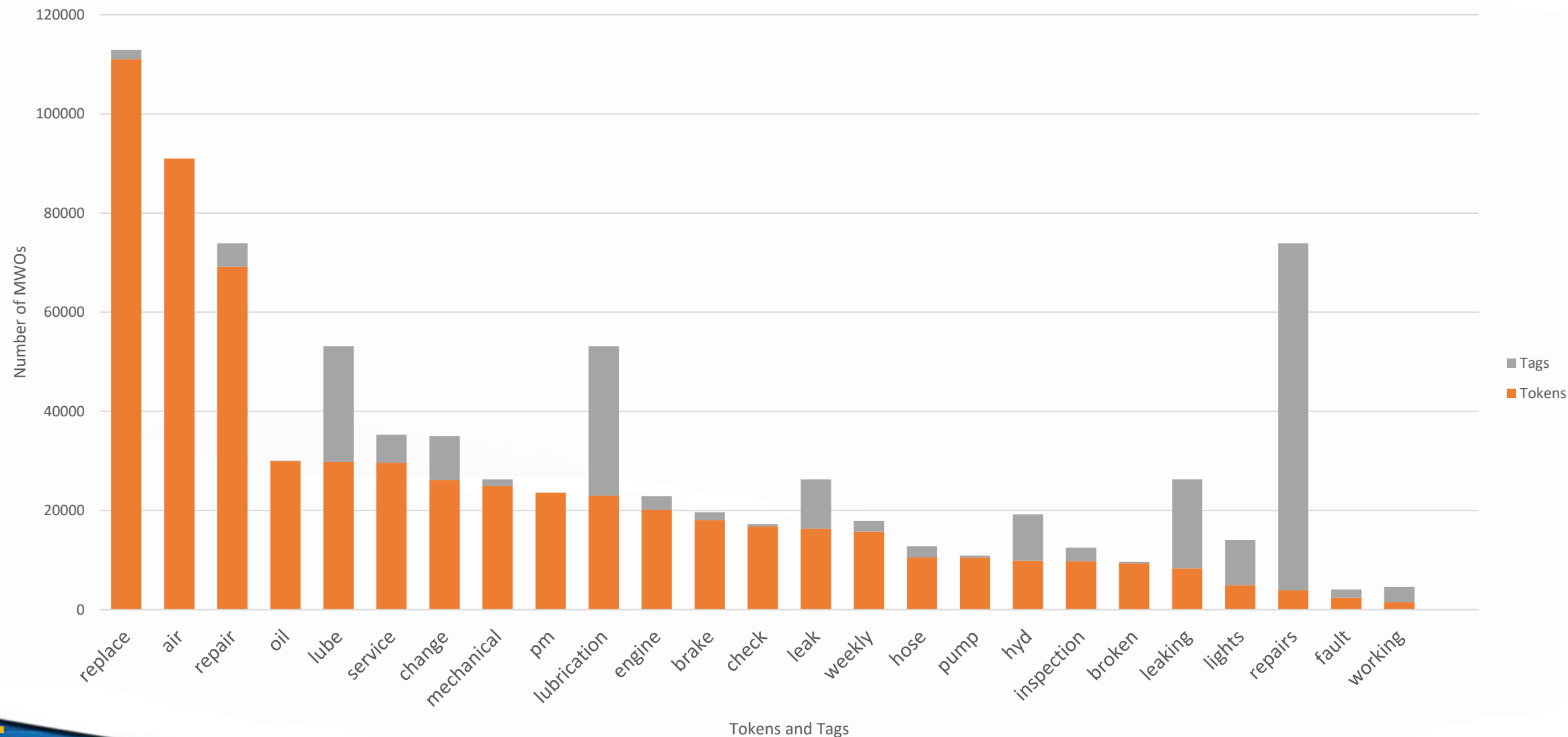
Description	Resolution	Major System	Problem(s)	Solution(s)	Rule(s)
"Hyd leak at saw attachment"	"Replaced seal in saw attachment but still"	Hydraulic; saw;	Hvdraulic Leak	Renplaced seal	Rule 1_4_5
"HP coolant pressure at 75 psi"				ut re	Rule 3_6_7_8
"Major hydraulic leak at Sp#6 horseshoe"				seal	Rule 2_4_9
"Clamping spool guard broken"	"Replaced – Operator could have done this!"	Clamp	Clamp broken	Replaced clamp	Rule 10_11_12

**Months for
5485 MWOs**

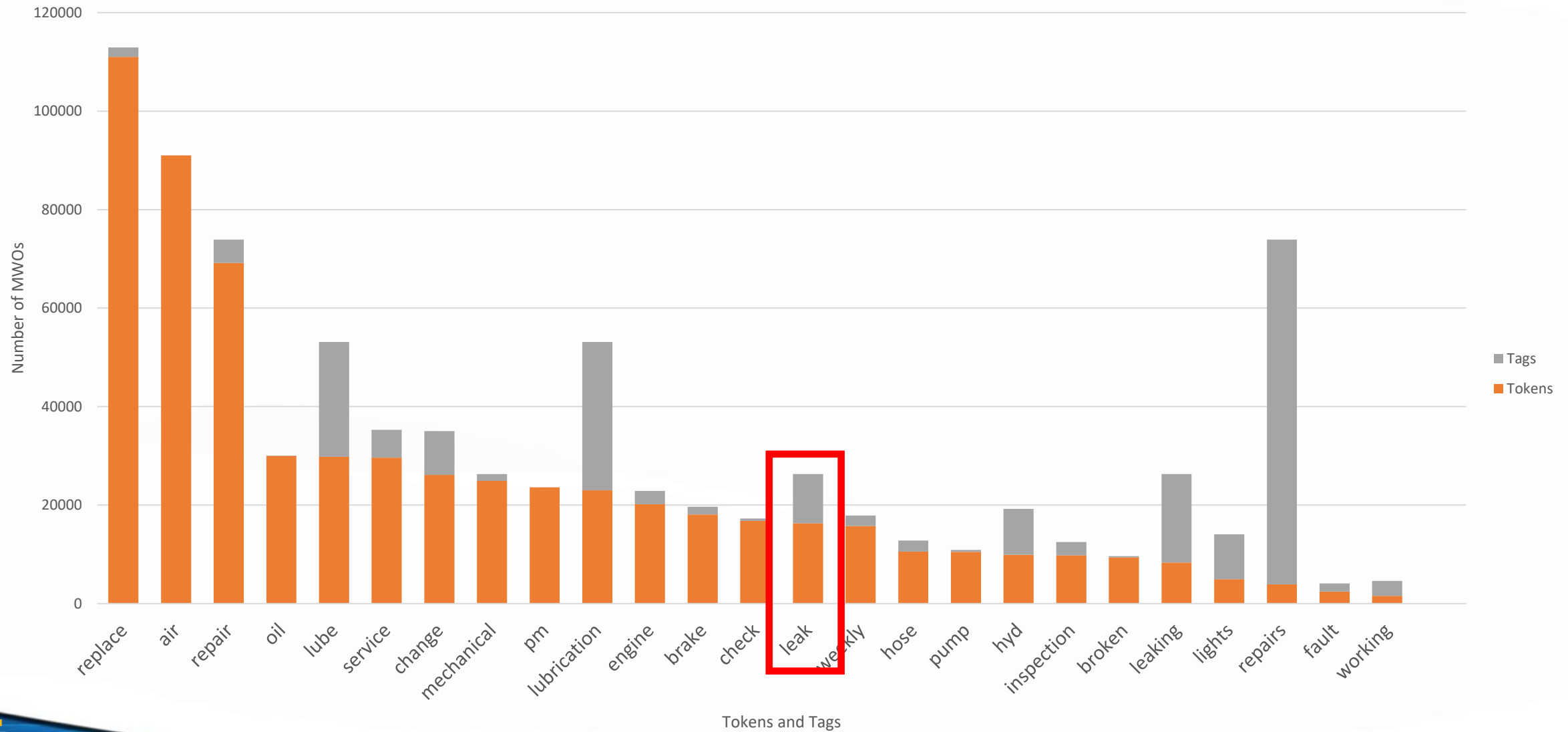
Tagging



Tagging

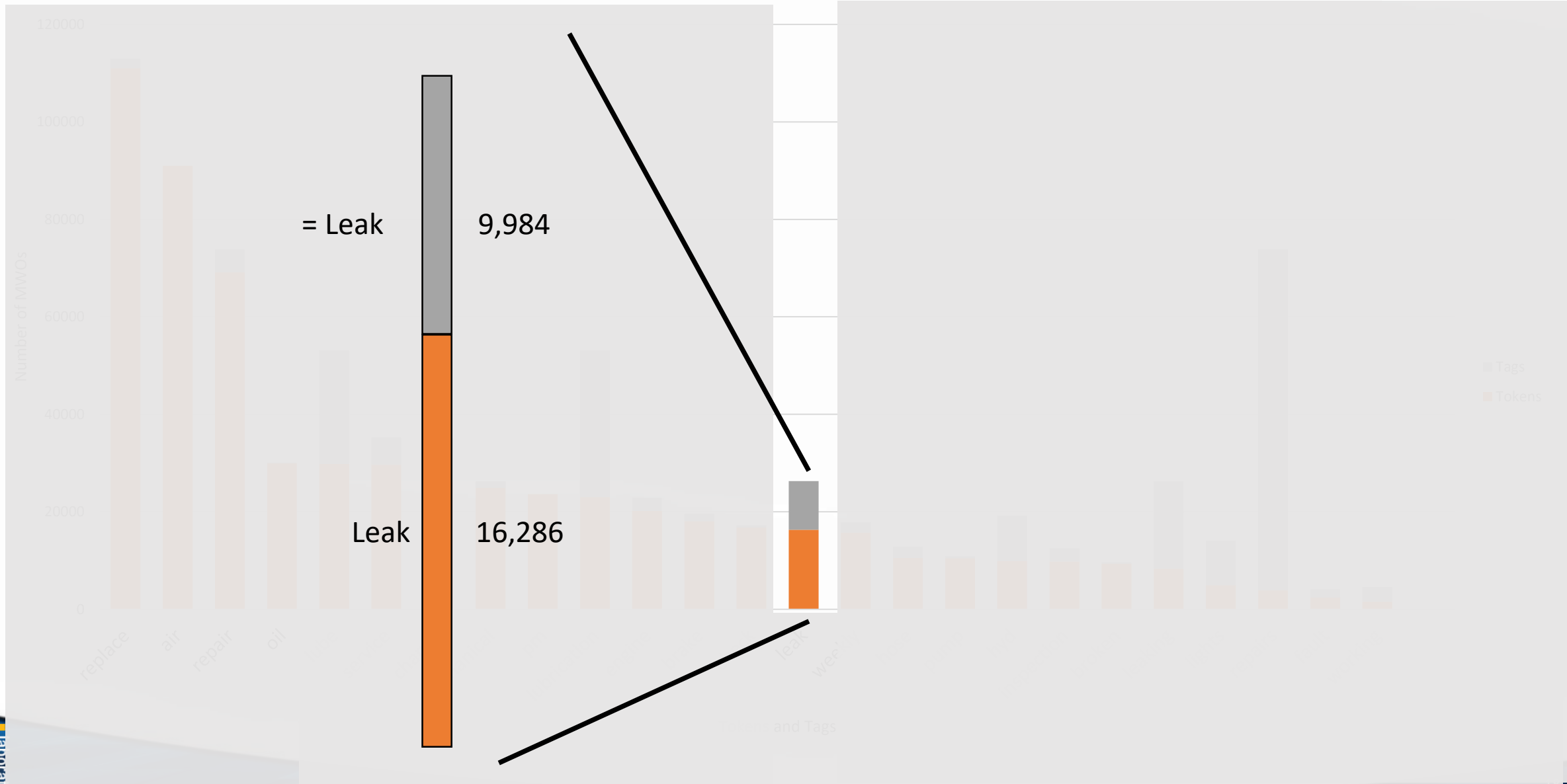


Tagging

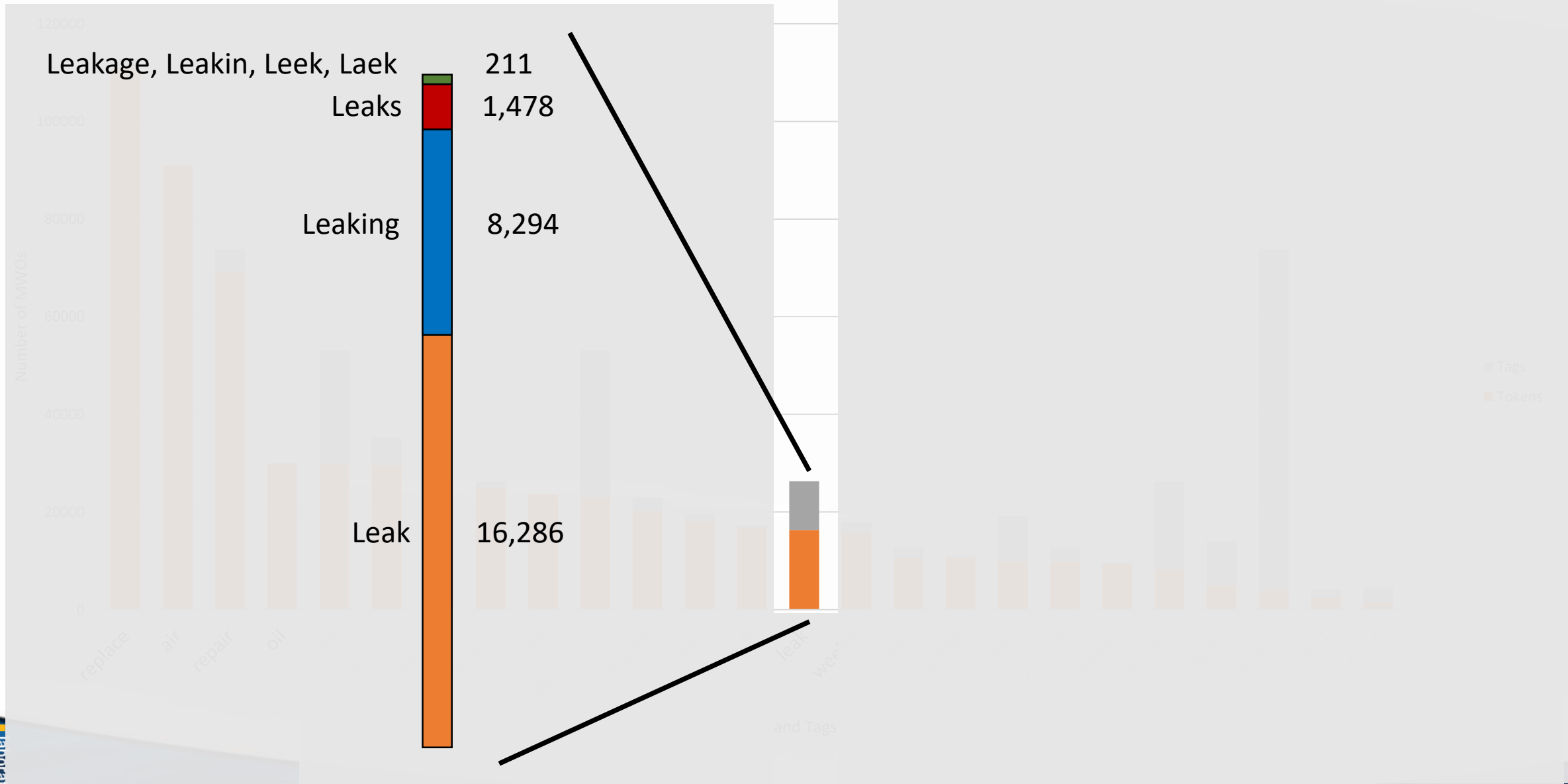


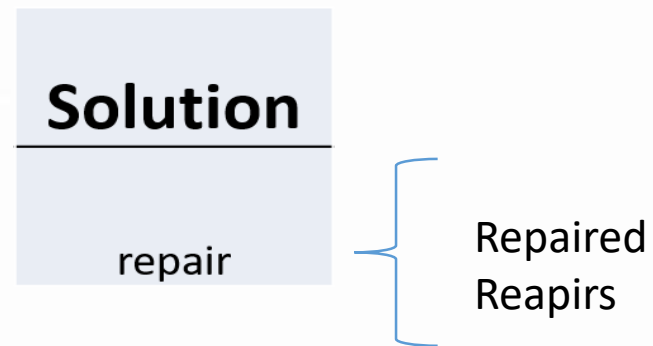
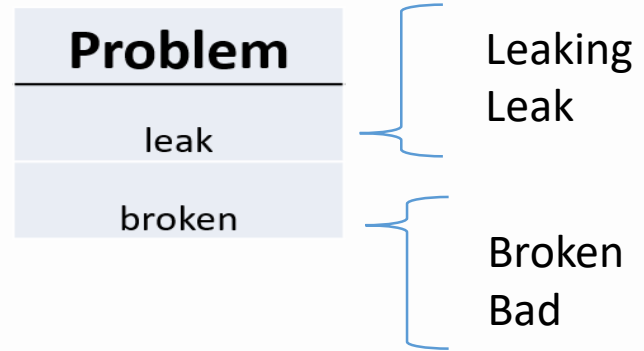
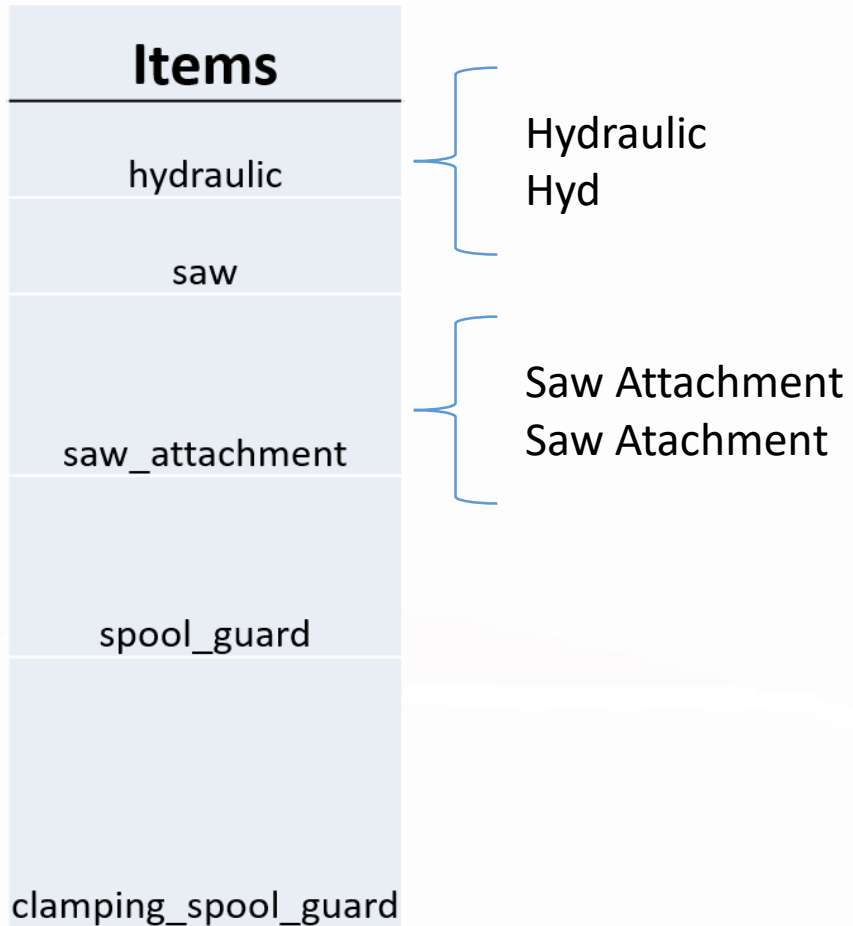
Tokens and Tags

Tagging



Tagging





Manual Tagging

Description	Resolution	Item(s)	Problem(s)	Solution(s)
"Hyd leak at saw attachment"	"Replaced seal in saw attachment but still leaking – Reapirs pending with ML"	Hydraulic; Saw attachment; Seal	Leak	Replaced; Repaired
"HP coolant pressure at 75 psi"	"Bad Gauge / Low pressure lines cleaned ou"	High Pressure Coolant; Gauge; Low Pressure Line	Broken; Low Pressure	Cleaned
"Major hydraulic leak at Sp#6 horseshoe"	"Repaired horseshoe seals"	Hydraulic; SP#6 Horseshoe, Seal	Leak	Repaired
"Clamping spool guard broken"	"Replaced – Operator could have done this!"	Clamping Spool Guard; Operator	Broken	Replaced

Manual Tagging

Description	Resolution	Cause	Effect	Solutions
"Hyd leak at saw attachment"	"Replaced seal in saw attachment but still..."		Hydraulic Leak at saw	Replaced Seal; Repaired
"HP coolant pressure at 75 psi"	<div style="border: 2px solid blue; border-radius: 25px; padding: 20px; text-align: center;"> <h2 style="margin: 0;">12 hours for 1200 MWOs</h2> </div>			Cleaned Out Low Pressure Lines
"Major hydraulic leak at Sp#6 horseshoe"				Repaired Horseshoe seals
"Clamping spool guard broken"	"Replaced – Operator could have done this!"	Operator error	Broken Clamping Spool Guard	Replaced Clamping Spool Guard

Ranked Tagging

Description

Resolution

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token	type	alias
replaced		
hydraulic		
leak		
seal		
repaired		
bad		
gauge		
low pressure		
reapirs		
hyd		



More Important

Ranked Tagging

Description

Resolution

"Hyd leak at saw attachment"	"Replaced seal in saw attachment but still leaking – Reapirs pending with ML"
"HP coolant pressure at 75 psi"	"Bad Gauge / Low pressure lines cleaned ou"
"Major hydraulic leak at Sp#6 horseshoe"	"Repaired horseshoe seals"
"Clamping spool guard broken"	"Replaced – Operator could have done this!"

token	type	alias
replaced	S	
hydraulic	I	
leak	P	
seal	I	
repaired	S	
bad	P	
gauge	I	
low pressure	P	
reapirs	I	
hyd	I	



More Important

Ranked Tagging

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Resolution

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"Major hydraulic leak at Sp#6 horseshoe"	"Repaired horseshoe seals"
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token	type	alias
replaced	S	
hydraulic	I	
leak	P	
seal	I	
repaired	S	
bad	P	broken
gauge	I	
low pressure	P	
reapirs	I	repair
hyd	I	hydraulic



More Important

Ranked Tagging

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"HP coolant pressure at 75 psi"	"Bad Gauge / Low pressure lines cleaned ou"			
"Major hydraulic leak at Sp#6 horseshoe"	"Repaired horseshoe seals"	Hydraulic		
"Clamping spool guard broken"	"Replaced – Operator could have done this!"			Replaced

Ranked Tagging

Description

Resolution

Item(s)

Problem(s)

Solution(s)

“Hyd leak at saw attachment”

“Replaced seal in saw attachment but still leaking – Reapirs pending with ML”

Hydraulic; Saw attachment; Seal

Leak

Replaced; Repaired

“HP coolant pressure at 75 psi”

“Bad Gauge / Low pressure lines cleaned ou”

High Pressure Coolant; Gauge; Low Pressure Line

Broken; Low Pressure

Cleaned

“Major hydraulic leak at Sp#6 horseshoe”

“Repaired horseshoe seals”

Hydraulic; SP#6 Horseshoe, Seal

Leak

Repaired

“Clamping spool guard broken”

“Replaced – Operator could have done this!”

Clamping Spool Guard; Operator

Broken

Replaced

Ranked Tagging

Description	Resolution	Cause	Effect	Solutions
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"HP coolant pressure at 75 psi"				Cleaned Out Low Pressure Lines
"Major hydraulic leak at Sp#6 horseshoe"				Repaired Horseshoe seals
"Clamping spool guard broken"	"Replaced – Operator could have done this!"	Operator error	Broken Clamping Spool Guard	Replaced Clamping Spool Guard

**1 hour for
3400 MWOs**

Transforming the MWO Data

	Time Inv.	Result
Previous annotation	12 hours	800 labels
Tagging method	12 hours	1200 tagged
Rules-Based	Months	5485 classified
Ranked Tagging	1 hour	3400 tagged, 5400 partials

Future Work

- Tagging UI refinement and industry user studies
- Visualization UI
 - Explore alternative visualizations
- Improve tagging tool: <https://github.com/usnistgov/nestor>
- Develop standard guidelines through ASME PHM Subcommittee

Questions?

Michael Brundage

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