A ontologia PHM para realizar o prognóstico de falhas deve possuir informações de Diagnóstico de falhas e Monitoramento de condições. Realizando interações entre esses dois grupos podemos ter resultados de RUL e consequentemente a ETTF.

Nesta primeira parte a ontologia serve para fazer consultas do Diagnóstico de falas.

**Senário:** realizar o diagnóstico de uma máquina mecânica que pertence ao equipamento “bomba centrífuga com acionamento separado\_1”

PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

PREFIX owl: <http://www.w3.org/2002/07/owl#>

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>

PREFIX utfpr: <http://www.semanticweb.org/david/ontologies/2016/untitled-ontology-286#>

Consulta 1: quais são as máquinas que pertencem ao equipamento “WaterPumpSeparateDriver\_1”?

SELECT ?Machine

WHERE { ?Machine utfpr:isPartOf utfpr:WaterPumpSeparateDriver\_1 }

**Resultado:**

|  |
| --- |
| **Machine** |
| CentrifugalPump\_1 |
| ElectricMotor\_1 |

Consulta 2: Qual é a função requerida da máquina mecânica “CentrifugalPump\_1”, seu ID e a qual equipamento pertence?

SELECT ?Required\_Function ?ID ?Belonging\_to

WHERE { utfpr:CentrifugalPump\_1 utfpr:hasFunction ?Required\_Function;

utfpr:hasID ?ID;

utfpr:isPartOf ?Belonging\_to}

**Resultado:**

|  |  |  |
| --- | --- | --- |
| **Required\_Function** | **ID** | **Belonging\_to** |
| "Water transport from A to B, at a given flow rate, in m3/h" | "BOM0225" | WaterPumpSeparateDriver\_1 |

**Consulta 3**: Quais são os componentes da máquina mecânica “**CentrifugalPump\_1”** passiveis de monitoramento?

SELECT ?Components

WHERE {?Components utfpr:isPartOf utfpr:CentrifugalPump\_1}

**Resultado:**

|  |
| --- |
| **Components** |
| RollingBearing\_1 |
| Coupling\_1 |
| Impeller\_1 |
| Lubricant\_1 |
| MechanicalSeal\_1 |
| Shaft\_1 |

**Consulta 4**: Qual é a função requerida do componente “**RollingBearing\_1”**, qual é seu Código e a qual máquina pertence?

SELECT ?Required\_Function ?Code ?Belonging\_to

WHERE { utfpr:RollingBearing\_1 utfpr:hasFunction ?Required\_Function;

utfpr:hasCode ?Code;

utfpr:isPartOf ?Belonging\_to}

**Resultado:**

|  |  |  |
| --- | --- | --- |
| **Required\_Function** | **Code** | **Belonging\_to** |
| "Support and allows the shaft rotates without friction, at a given rpm" | "6306\_C3" | CentrifugalPump\_1 |

**Consulta 5**: Qual é o componente que tem o código **6306\_C3**?

SELECT ?Component

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string }

Outra forma:

SELECT ?Component

WHERE {?Component utfpr:hasCode ?valor

FILTER (?valor="6306\_C3") }

**Resultado:**

|  |
| --- |
| **Component** |
| RollingBearing\_1 |

**Consulta 6:** Quais são os modos de falha do componente **RollingBearing\_1**?

SELECT ?Component ?Failure

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure}

Outra forma:

SELECT ?Component ?Failure

WHERE {?Component utfpr:hasCode ?valor

FILTER (?valor="6306\_C3")

?Component utfpr:hasMode ?Failure}

**Resultado:**

|  |  |
| --- | --- |
| **Component** | **Failure** |
| RollingBearing\_1 | Deformation\_1 |
| RollingBearing\_1 | Wear\_1 |
| RollingBearing\_1 | Fracture\_1 |

**Consulta 7:** Quais são as causas potenciais de cada modo de falha do componente **RollingBearing\_1**?

SELECT ?Component ?Failure ?Cause

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause}

**Resultado:**

|  |  |  |
| --- | --- | --- |
| **Component** | **Failure** | **Cause** |
| RollingBearing\_1 | Fracture\_1 | 16-Fatigue\_in\_rolling\_bearing\_parts\_by\_housing\_misalignment |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft |
| RollingBearing\_1 | Fracture\_1 | 18-Ductile\_crack\_due\_to\_excessive\_tightening\_on\_the\_sides\_of\_the\_bearing |
| RollingBearing\_1 | Fracture\_1 | 21-Fatigue\_due\_to\_fastening\_screws\_loose |
| RollingBearing\_1 | Fracture\_1 | 19-Ductile\_crack\_due\_to\_interference\_fit\_above\_of\_specified |
| RollingBearing\_1 | Fracture\_1 | 20-Ductile\_crack\_due\_to\_lack\_of\_free\_side\_for\_dilation |
| RollingBearing\_1 | Deformation\_1 | 14-Angular\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect |
| RollingBearing\_1 | Deformation\_1 | 15-Parallel\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect |
| RollingBearing\_1 | Wear\_1 | 4-Fretting\_wear\_due\_to\_lack\_tightening\_on\_the\_bearing\_sides-looseness |
| RollingBearing\_1 | Wear\_1 | 7-Fretting\_wear\_due\_to\_excessive\_amount\_of\_lubricant-swirling |
| RollingBearing\_1 | Wear\_1 | 9-Wear\_of\_parts\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant\_with\_abrasive\_particles |
| RollingBearing\_1 | Wear\_1 | 3-Adhesive\_wear\_due\_to\_low\_lubricant\_level |
| RollingBearing\_1 | Wear\_1 | 11-Bearing\_loose\_due\_to\_fracture\_in\_screw\_threads |
| RollingBearing\_1 | Wear\_1 | 2-Adhesive\_wear\_due\_to\_incorrect\_lubricant\_specification |
| RollingBearing\_1 | Wear\_1 | 6-Fretting\_wear\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant-forming\_blistering |
| RollingBearing\_1 | Wear\_1 | 13-Bolt\_specification\_with\_lower\_yield\_strength\_than\_required |
| RollingBearing\_1 | Wear\_1 | 5-Fretting\_wear\_due\_to\_vibration\_of\_bearing\_housing |

**Consulta 8:** Quais são as causas potenciais e efeitos de cada modo de falha do componente **RollingBearing\_1**?

SELECT ?Component ?Failure ?Cause ?Effect

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect}

**Resultado:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **Failure** | **Cause** | **Effect** |
| RollingBearing\_1 | Fracture\_1 | 16-Fatigue\_in\_rolling\_bearing\_parts\_by\_housing\_misalignment | OperationImpaired\_1 |
| RollingBearing\_1 | Fracture\_1 | 17- Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 |
| RollingBearing\_1 | Fracture\_1 | 18-Ductile\_crack\_due\_to\_excessive\_tightening\_on\_the\_sides\_of\_the\_bearing | OperationImpaired\_1 |
| RollingBearing\_1 | Fracture\_1 | 21-Fatigue\_due\_to\_fastening\_screws\_loose | OperationImpaired\_1 |
| RollingBearing\_1 | Fracture\_1 | 19-Ductile\_crack\_due\_to\_interference\_fit\_above\_of\_specified | OperationImpaired\_1 |
| RollingBearing\_1 | Fracture\_1 | 20-Ductile\_crack\_due\_to\_lack\_of\_free\_side\_for\_dilation | OperationImpaired\_1 |
| RollingBearing\_1 | Deformation\_1 | 14-Angular\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 |
| RollingBearing\_1 | Deformation\_1 | 15-Parallel\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 |
| RollingBearing\_1 | Wear\_1 | 4-Fretting\_wear\_due\_to\_lack\_tightening\_on\_the\_bearing\_sides-looseness | Sound\_1 |
| RollingBearing\_1 | Wear\_1 | 7-Fretting\_wear\_due\_to\_excessive\_amount\_of\_lubricant-swirling | Sound\_1 |
| RollingBearing\_1 | Wear\_1 | 9-Wear\_of\_parts\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant\_with\_abrasive\_particles | Sound\_1 |
| RollingBearing\_1 | Wear\_1 | 3-Adhesive\_wear\_due\_to\_low\_lubricant\_level | Sound\_1 |
| RollingBearing\_1 | Wear\_1 | 11-Bearing\_loose\_due\_to\_fracture\_in\_screw\_threads | Sound\_1 |
| RollingBearing\_1 | Wear\_1 | 2-Adhesive\_wear\_due\_to\_incorrect\_lubricant\_specification | Sound\_1 |
| RollingBearing\_1 | Wear\_1 | 6-Fretting\_wear\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant-forming\_blistering | Sound\_1 |
| RollingBearing\_1 | Wear\_1 | 13-Bolt\_specification\_with\_lower\_yield\_strength\_than\_required | Sound\_1 |
| RollingBearing\_1 | Wear\_1 | 5-Fretting\_wear\_due\_to\_vibration\_of\_bearing\_housing | Sound\_1 |

**Consulta 9:** Quais são os modos de falha, causas potenciais, efeitos e sua severidade (SEV) do componente **RollingBearing\_1**?

SELECT ?Component ?Failure ?Cause ?Effect ?SEV

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV }

**Resultado:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **Failure** | **Cause** | **Effect** | **SEV** |
| RollingBearing\_1 | Fracture\_1 | Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft/housing | OperationImpaired\_1 | "**4**" |
| RollingBearing\_1 | Fracture\_1 | Fatigue\_due\_to\_loose\_fastening\_screws | OperationImpaired\_1 | "4" |
| RollingBearing\_1 | Fracture\_1 | Ductile\_crack\_due\_to\_interference\_fit\_above\_of\_specified | OperationImpaired\_1 | "4" |
| RollingBearing\_1 | Fracture\_1 | Ductile\_crack\_due\_to\_excessive\_tightening\_on\_the\_sides\_of\_the\_bearing | OperationImpaired\_1 | "4" |
| RollingBearing\_1 | Fracture\_1 | Ductile\_crack\_due\_to\_lack\_of\_free\_side\_for\_dilation | OperationImpaired\_1 | "4" |
| RollingBearing\_1 | Fracture\_1 | Fatigue\_in\_rolling\_bearing\_parts\_by\_housing\_misalignment | OperationImpaired\_1 | "4" |
| RollingBearing\_1 | Deformation\_1 | Parallel\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 | "3" |
| RollingBearing\_1 | Deformation\_1 | Incorrect\_bolt\_specification-lower\_yield\_strength\_than\_required | Overheat\_1 | "3" |
| RollingBearing\_1 | Deformation\_1 | Angular\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 | "3" |
| RollingBearing\_1 | Wear\_1 | Adhesive\_wear\_due\_to\_incorrect\_lubricant\_specification | Sound\_1 | "2" |
| RollingBearing\_1 | Wear\_1 | Fretting\_wear\_due\_to\_excessive\_amount\_of\_lubricant-swirling | Sound\_1 | "2" |
| RollingBearing\_1 | Wear\_1 | Adhesive\_wear\_due\_to\_low\_lubricant\_level | Sound\_1 | "2" |
| RollingBearing\_1 | Wear\_1 | Fretting\_wear\_due\_to\_lack\_tightening-looseness-on\_the\_bearing\_sides | Sound\_1 | "2" |
| RollingBearing\_1 | Wear\_1 | Fretting\_wear\_due\_to\_adjustment\_out\_of\_specification-looseness\_between\_parts | Sound\_1 | "2" |
| RollingBearing\_1 | Wear\_1 | Fretting\_wear\_due\_to\_lubricant\_contamination\_forming\_blistering-poor\_sealing | Sound\_1 | "2" |
| RollingBearing\_1 | Wear\_1 | Adhesive\_wear\_due\_to\_load\_above\_projected\_capacity | Sound\_1 | "2" |
| RollingBearing\_1 | Wear\_1 | Fretting\_wear-due-to\_vibration\_of\_bearing\_housing | Sound\_1 | "2" |

**Consulta 10:** Quais são os modos de falha, causas potenciais, efeitos, sua severidade (SEV) e sintomas do componente **RollingBearing\_1**?

SELECT ?Component ?Failure ?Cause ?Effect ?SEV ?Symptom

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV.

?Cause utfpr:hasSymptom ?Symptom}

**Resultado:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Component** | **Failure** | **Cause** | **Effect** | **S**  **E**  **V** | **Symptom** |
| RollingBearing\_1 | Fracture\_1 | 16-Fatigue\_in\_rolling\_bearing\_parts\_by\_housing\_misalignment | OperationImpaired\_1 | "4" | Vibration\_12 |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 | "4" | Vibration\_13 |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 | "4" | Temperature\_2 |
| RollingBearing\_1 | Fracture\_1 | 18-Ductile\_crack\_due\_to\_excessive\_tightening\_on\_the\_sides\_of\_the\_bearing | OperationImpaired\_1 | "4" | Vibration\_14 |
| RollingBearing\_1 | Fracture\_1 | 21-Fatigue\_due\_to\_fastening\_screws\_loose | OperationImpaired\_1 | "4" | Vibration\_15 |
| RollingBearing\_1 | Fracture\_1 | 19-Ductile\_crack\_due\_to\_interference\_fit\_above\_of\_specified | OperationImpaired\_1 | "4" | Temperature\_3 |
| RollingBearing\_1 | Fracture\_1 | 20-Ductile\_crack\_due\_to\_lack\_of\_free\_side\_for\_dilation | OperationImpaired\_1 | "4" | Temperature\_4 |
| RollingBearing\_1 | Deformation\_1 | 14-Angular\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 | "3" | Vibration\_10 |
| RollingBearing\_1 | Deformation\_1 | 15-Parallel\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 | "3" | Vibration\_11 |
| RollingBearing\_1 | Wear\_1 | 4-Fretting\_wear\_due\_to\_lack\_tightening\_on\_the\_bearing\_sides-looseness | Sound\_1 | "2" | Vibration\_2 |
| RollingBearing\_1 | Wear\_1 | 7-Fretting\_wear\_due\_to\_excessive\_amount\_of\_lubricant-swirling | Sound\_1 | "2" | Vibration\_4 |
| RollingBearing\_1 | Wear\_1 | 9-Wear\_of\_parts\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant\_with\_abrasive\_particles | Sound\_1 | "2" | LubricantProperty\_3 |
| RollingBearing\_1 | Wear\_1 | 3-Adhesive\_wear\_due\_to\_low\_lubricant\_level | Sound\_1 | "2" | Temperature\_1 |
| RollingBearing\_1 | Wear\_1 | 11-Bearing\_loose\_due\_to\_fracture\_in\_screw\_threads | Sound\_1 | "2" | Vibration\_7 |

**Consulta11:** Quais são os modos de falha, causas potenciais, efeitos, sua severidade (SEV), sintomas e DGN do componente **RollingBearing\_1**?

SELECT ?Component ?Failure ?Cause ?Effect ?SEV ?Symptom ?DGN

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV.

?Cause utfpr:hasSymptom ?Symptom.

?Symptom utfpr:hasDGN ?DGN}

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Component** | **Failure** | **Cause** | **Effect** | **S**  **E**  **V** | **Symptom** | **DGN** |
| RollingBearing\_1 | Fracture\_1 | 16-Fatigue\_in\_rolling\_bearing\_parts\_by\_housing\_misalignment | OperationImpaired\_1 | "4" | Vibration\_12 | "5" |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 | "4" | Vibration\_13 | "3" |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 | "4" | Temperature\_2 | "3" |
| RollingBearing\_1 | Fracture\_1 | 18-Ductile\_crack\_due\_to\_excessive\_tightening\_on\_the\_sides\_of\_the\_bearing | OperationImpaired\_1 | "4" | Vibration\_14 | "3" |
| RollingBearing\_1 | Fracture\_1 | 21-Fatigue\_due\_to\_fastening\_screws\_loose | OperationImpaired\_1 | "4" | Vibration\_15 | "5" |
| RollingBearing\_1 | Fracture\_1 | 19-Ductile\_crack\_due\_to\_interference\_fit\_above\_of\_specified | OperationImpaired\_1 | "4" | Temperature\_3 | "3" |
| RollingBearing\_1 | Fracture\_1 | 20-Ductile\_crack\_due\_to\_lack\_of\_free\_side\_for\_dilation | OperationImpaired\_1 | "4" | Temperature\_4 | "3" |
| RollingBearing\_1 | Deformation\_1 | 14-Angular\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 | "3" | Vibration\_10 | "3" |
| RollingBearing\_1 | Deformation\_1 | 15-Parallel\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 | "3" | Vibration\_11 | "3" |
| RollingBearing\_1 | Wear\_1 | 4-Fretting\_wear\_due\_to\_lack\_tightening\_on\_the\_bearing\_sides-looseness | Sound\_1 | "2" | Vibration\_2 | "4" |
| RollingBearing\_1 | Wear\_1 | 7-Fretting\_wear\_due\_to\_excessive\_amount\_of\_lubricant-swirling | Sound\_1 | "2" | Vibration\_4 | "5" |
| RollingBearing\_1 | Wear\_1 | 9-Wear\_of\_parts\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant\_with\_abrasive\_particles | Sound\_1 | "2" | LubricantProperty\_3 | "5" |
| RollingBearing\_1 | Wear\_1 | 3-Adhesive\_wear\_due\_to\_low\_lubricant\_level | Sound\_1 | "2" | Temperature\_1 | "3" |
| RollingBearing\_1 | Wear\_1 | 11-Bearing\_loose\_due\_to\_fracture\_in\_screw\_threads | Sound\_1 | "2" | Vibration\_7 | "5" |
| RollingBearing\_1 | Wear\_1 | 2-Adhesive\_wear\_due\_to\_incorrect\_lubricant\_specification | Sound\_1 | "2" | LubricantProperty\_1 | "5" |
| RollingBearing\_1 | Wear\_1 | 6-Fretting\_wear\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant-forming\_blistering | Sound\_1 | "2" | LubricantProperty\_2 | "5" |
| RollingBearing\_1 | Wear\_1 | 13-Bolt\_specification\_with\_lower\_yield\_strength\_than\_required | Sound\_1 | "2" | Vibration\_9 | "3" |
| RollingBearing\_1 | Wear\_1 | 5-Fretting\_wear\_due\_to\_vibration\_of\_bearing\_housing | Sound\_1 | "2" | Vibration\_3 | "4" |
| RollingBearing\_1 | Wear\_1 | 12-Incorrect\_tightening\_due\_to\_lack\_of\_tools | Sound\_1 | "2" | Vibration\_8 | "4" |
| RollingBearing\_1 | Wear\_1 | 8-Wear\_due\_to\_lack\_of\_tightening\_of\_parts-looseness | Sound\_1 | "2" | Vibration\_5 | "5" |
| RollingBearing\_1 | Wear\_1 | 10-Pitting\_corrosion\_due\_to\_contamination\_of\_the\_lubricant | Sound\_1 | "2" | Vibration\_6 | "4" |
| RollingBearing\_1 | Wear\_1 | 1-Adhesive\_wear\_due\_to\_load\_above\_projected\_capacity | Sound\_1 | "2" | Vibration\_1 | "5" |

**Consulta12:** Quais são os modos de falha, causas potenciais, efeitos, sua severidade (SEV), sintomas, DGN e técnica de medição recomendada para o componente **RollingBearing\_1**?

SELECT ?Component ?Failure ?Cause ?Effect ?SEV ?Symptom ?DGN ?Technique

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV.

?Cause utfpr:hasSymptom ?Symptom.

?Symptom utfpr:hasDGN ?DGN;

utfpr:isDetectedWith ?Technique}

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Component** | **Failure** | **Cause** | **Effect** | **S**  **E**  **V** | **Symptom** | **DGN** | **Technique** |
| RollingBearing\_1 | Wear\_1 | 4-Fretting\_wear\_due\_to\_lack\_tightening\_on\_the\_bearing\_sides-looseness | Sound\_1 | "2" | Vibration\_2 | "4" | VibrationAnalysis |
| RollingBearing\_1 | Wear\_1 | 7-Fretting\_wear\_due\_to\_excessive\_amount\_of\_lubricant-swirling | Sound\_1 | "2" | Vibration\_4 | "5" | VibrationAnalysis |
| RollingBearing\_1 | Wear\_1 | 9-Wear\_of\_parts\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant\_with\_abrasive\_particles | Sound\_1 | "2" | LubricantProperty\_3 | "5" | OilAnalysis |
| RollingBearing\_1 | Wear\_1 | 3-Adhesive\_wear\_due\_to\_low\_lubricant\_level | Sound\_1 | "2" | Temperature\_1 | "3" | InfraredThermography |
| RollingBearing\_1 | Wear\_1 | 11-Bearing\_loose\_due\_to\_fracture\_in\_screw\_threads | Sound\_1 | "2" | Vibration\_7 | "5" | VibrationAnalysis |
| RollingBearing\_1 | Wear\_1 | 11-Bearing\_loose\_due\_to\_fracture\_in\_screw\_threads | Sound\_1 | "2" | Vibration\_7 | "5" | VisulInspection |
| RollingBearing\_1 | Wear\_1 | 2-Adhesive\_wear\_due\_to\_incorrect\_lubricant\_specification | Sound\_1 | "2" | LubricantProperty\_1 | "5" | OilAnalysis |
| RollingBearing\_1 | Wear\_1 | 6-Fretting\_wear\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant-forming\_blistering | Sound\_1 | "2" | LubricantProperty\_2 | "5" | OilAnalysis |
| RollingBearing\_1 | Wear\_1 | 13-Bolt\_specification\_with\_lower\_yield\_strength\_than\_required | Sound\_1 | "2" | Vibration\_9 | "3" | VibrationAnalysis |
| RollingBearing\_1 | Wear\_1 | 5-Fretting\_wear\_due\_to\_vibration\_of\_bearing\_housing | Sound\_1 | "2" | Vibration\_3 | "4" | VibrationAnalysis |
| RollingBearing\_1 | Wear\_1 | 12-Incorrect\_tightening\_due\_to\_lack\_of\_tools | Sound\_1 | "2" | Vibration\_8 | "4" | VibrationAnalysis |
| RollingBearing\_1 | Wear\_1 | 8-Wear\_due\_to\_lack\_of\_tightening\_of\_parts-looseness | Sound\_1 | "2" | Vibration\_5 | "5" | VibrationAnalysis |
| RollingBearing\_1 | Wear\_1 | 10-Pitting\_corrosion\_due\_to\_contamination\_of\_the\_lubricant | Sound\_1 | "2" | Vibration\_6 | "4" | VibrationAnalysis |
| RollingBearing\_1 | Wear\_1 | 1-Adhesive\_wear\_due\_to\_load\_above\_projected\_capacity | Sound\_1 | "2" | Vibration\_1 | "5" | VibrationAnalysis |

**Consulta13:** Quais são os modos de falha, causas potenciais, efeitos, sua severidade (SEV), sintomas, DGN, técnica de medição recomendada e DET para o componente **RollingBearing\_1**?

SELECT ?Component ?Failure ?Cause ?Effect ?SEV ?Symptom ?DGN ?Technique ?DET

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV.

?Cause utfpr:hasSymptom ?Symptom.

?Symptom utfpr:hasDGN ?DGN;

utfpr:isDetectedWith ?Technique;

utfpr:hasDET ?DET}

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Component** | **Failure** | **Cause** | **Effect** | **S**  **E**  **V** | **Symptom** | **DGN** | **Technique** | **DET** |
| RollingBearing\_1 | Fracture\_1 | 16-Fatigue\_in\_rolling\_bearing\_parts\_by\_housing\_misalignment | OperationImpaired\_1 | "4" | Vibration\_12 | "5" | VibrationAnalysis | "5" |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 | "4" | Vibration\_13 | "3" | VibrationAnalysis | "4" |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 | "4" | Temperature\_2 | "3" | InfraredThermography | "4" |
| RollingBearing\_1 | Fracture\_1 | 18-Ductile\_crack\_due\_to\_excessive\_tightening\_on\_the\_sides\_of\_the\_bearing | OperationImpaired\_1 | "4" | Vibration\_14 | "3" | VibrationAnalysis | "4" |
| RollingBearing\_1 | Fracture\_1 | 21-Fatigue\_due\_to\_fastening\_screws\_loose | OperationImpaired\_1 | "4" | Vibration\_15 | "5" | VibrationAnalysis | "5" |
| RollingBearing\_1 | Fracture\_1 | 19-Ductile\_crack\_due\_to\_interference\_fit\_above\_of\_specified | OperationImpaired\_1 | "4" | Temperature\_3 | "3" | InfraredThermography | "4" |
| RollingBearing\_1 | Fracture\_1 | 20-Ductile\_crack\_due\_to\_lack\_of\_free\_side\_for\_dilation | OperationImpaired\_1 | "4" | Temperature\_4 | "3" | InfraredThermography | "4" |
| RollingBearing\_1 | Deformation\_1 | 14-Angular\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 | "3" | Vibration\_10 | "3" | VibrationAnalysis | "3" |
| RollingBearing\_1 | Deformation\_1 | 15-Parallel\_misalignment\_of\_shaft\_due\_to\_mounting\_incorrect | Overheat\_1 | "3" | Vibration\_11 | "3" | VibrationAnalysis | "3" |
| RollingBearing\_1 | Wear\_1 | 4-Fretting\_wear\_due\_to\_lack\_tightening\_on\_the\_bearing\_sides-looseness | Sound\_1 | "2" | Vibration\_2 | "4" | VibrationAnalysis | "4" |
| RollingBearing\_1 | Wear\_1 | 7-Fretting\_wear\_due\_to\_excessive\_amount\_of\_lubricant-swirling | Sound\_1 | "2" | Vibration\_4 | "5" | VibrationAnalysis | "4" |
| RollingBearing\_1 | Wear\_1 | 9-Wear\_of\_parts\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant\_with\_abrasive\_particles | Sound\_1 | "2" | LubricantProperty\_3 | "5" | OilAnalysis | "5" |
| RollingBearing\_1 | Wear\_1 | 3-Adhesive\_wear\_due\_to\_low\_lubricant\_level | Sound\_1 | "2" | Temperature\_1 | "3" | InfraredThermography | "5" |
| RollingBearing\_1 | Wear\_1 | 11-Bearing\_loose\_due\_to\_fracture\_in\_screw\_threads | Sound\_1 | "2" | Vibration\_7 | "5" | VibrationAnalysis | "5" |
| RollingBearing\_1 | Wear\_1 | 11-Bearing\_loose\_due\_to\_fracture\_in\_screw\_threads | Sound\_1 | "2" | Vibration\_7 | "5" | VisulInspection | "5" |
| RollingBearing\_1 | Wear\_1 | 2-Adhesive\_wear\_due\_to\_incorrect\_lubricant\_specification | Sound\_1 | "2" | LubricantProperty\_1 | "5" | OilAnalysis | "5" |
| RollingBearing\_1 | Wear\_1 | 6-Fretting\_wear\_due\_to\_poor\_sealing\_that\_contaminates\_the\_lubricant-forming\_blistering | Sound\_1 | "2" | LubricantProperty\_2 | "5" | OilAnalysis | "5" |
| RollingBearing\_1 | Wear\_1 | 13-Bolt\_specification\_with\_lower\_yield\_strength\_than\_required | Sound\_1 | "2" | Vibration\_9 | "3" | VibrationAnalysis | "3" |
| RollingBearing\_1 | Wear\_1 | 5-Fretting\_wear\_due\_to\_vibration\_of\_bearing\_housing | Sound\_1 | "2" | Vibration\_3 | "4" | VibrationAnalysis | "5" |
| RollingBearing\_1 | Wear\_1 | 12-Incorrect\_tightening\_due\_to\_lack\_of\_tools | Sound\_1 | "2" | Vibration\_8 | "4" | VibrationAnalysis | "3" |
| RollingBearing\_1 | Wear\_1 | 8-Wear\_due\_to\_lack\_of\_tightening\_of\_parts-looseness | Sound\_1 | "2" | Vibration\_5 | "5" | VibrationAnalysis | "3" |
| RollingBearing\_1 | Wear\_1 | 10-Pitting\_corrosion\_due\_to\_contamination\_of\_the\_lubricant | Sound\_1 | "2" | Vibration\_6 | "4" | VibrationAnalysis | "5" |
| RollingBearing\_1 | Wear\_1 | 1-Adhesive\_wear\_due\_to\_load\_above\_projected\_capacity | Sound\_1 | "2" | Vibration\_1 | "5" | VibrationAnalysis | "5" |

**Consulta 14:** Quais são os modos de falha, com SEV = 4, do componente **RollingBearing\_1**?

SELECT ?Component ?Failure ?Cause ?Effect ?SEV

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV;

utfpr:hasSEV "4"xsd:integer }

SELECT

?Component ?Failure ?Cause ?Effect ?SEV ?Symptom ?DGN ?Technique ?DET

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV.

?Cause utfpr:hasSymptom ?Symptom.

?Symptom utfpr:hasDGN ?DGN;

utfpr:isDetectedWith ?Technique;

utfpr:hasDET ?DET.

FILTER (?SEV = 4 )}

**Resultado:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Component** | **Failure** | **Cause** | **Effect** | **SEV** | **Symptom** | **DGN** | **Techniqye** | **DET** |
| RollingBearing\_1 | Fracture\_1 | 16-Fatigue\_in\_rolling\_bearing\_parts\_by\_housing\_misalignment | OperationImpaired\_1 | "4" | Vibration\_12 | "5" | VibrationAnalysis | "5" |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 | "4" | Vibration\_13 | "3" | VibrationAnalysis | "4" |
| RollingBearing\_1 | Fracture\_1 | 17-Fatigue\_in\_bearing\_parts\_by\_mounting\_under\_pressure\_between\_bearing\_and\_shaft | OperationImpaired\_1 | "4" | Temperature\_2 | "3" | InfraredThermography | "4" |
| RollingBearing\_1 | Fracture\_1 | 18-Ductile\_crack\_due\_to\_excessive\_tightening\_on\_the\_sides\_of\_the\_bearing | OperationImpaired\_1 | "4" | Vibration\_14 | "3" | VibrationAnalysis | "4" |
| RollingBearing\_1 | Fracture\_1 | 21-Fatigue\_due\_to\_fastening\_screws\_loose | OperationImpaired\_1 | "4" | Vibration\_15 | "5" | VibrationAnalysis | "5" |
| RollingBearing\_1 | Fracture\_1 | 19-Ductile\_crack\_due\_to\_interference\_fit\_above\_of\_specified | OperationImpaired\_1 | "4" | Temperature\_3 | "3" | InfraredThermography | "4" |
| RollingBearing\_1 | Fracture\_1 | 20-Ductile\_crack\_due\_to\_lack\_of\_free\_side\_for\_dilation | OperationImpaired\_1 | "4" | Temperature\_4 | "3" | InfraredThermography | "4" |

**Consulta 15:** Os modos de falha com SEV 4 e DGN 5

SELECT ?Component ?Failure ?Cause ?Effect ?SEV ?Symptom ?DGN ?Technique ?DET

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV.

?Cause utfpr:hasSymptom ?Symptom.

?Symptom utfpr:hasDGN ?DGN;

utfpr:isDetectedWith ?Technique;

utfpr:hasDET ?DET.

FILTER (?SEV = 4 )

FILTER (?DGN = 5 )}

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Componente** | **Failure** | **Cause** | **Effect** | **SEV** | **Symptom** | **DGN** | **Technique** | **DET** |
| RollingBearing\_1 | Fracture\_1 | 16-Fatigue\_in\_rolling\_bearing\_parts\_by\_housing\_misalignment | OperationImpaired\_1 | "4" | Vibration\_12 | "5" | VibrationAnalysis | "5" |
| RollingBearing\_1 | Fracture\_1 | 21-Fatigue\_due\_to\_fastening\_screws\_loose | OperationImpaired\_1 | "4" | Vibration\_15 | "5" | VibrationAnalysis | "5" |

SELECT DISTINCT ?tipo ?Component

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string .

?Component rdf:type ?tipo}

Ordenar de forma alfabética

SELECT DISTINCT ?Component ?modo WHERE {

?Component rdf:type utfpr:RollingBearing .

?Component utfpr:hasMode ?modo

} ORDER BY ?modo

Ordenar por SEV

SELECT DISTINCT ?Component ?Failure ?Cause ?Effect ?SEV

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:hasMode ?Failure.

?Failure utfpr:hasCause ?Cause;

utfpr:hasEffect ?Effect.

?Effect utfpr:hasSEV ?SEV } ORDER BY ?SEV

Mostrar os comentários em inglês

SELECT DISTINCT ?tipo ?Component ?comentario

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string .

?Component rdf:type ?tipo .

?tipo rdfs:comment ?comentario

FILTER (langMatches(lang(?comentario), "en"))}

PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

PREFIX owl: <http://www.w3.org/2002/07/owl#>

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>

PREFIX utfpr: < http://www.semanticweb.org/david/ontologies/2016/untitled-ontology-286#>

**Consulta 16**: Qual é o componente que tem o código **6306\_C3**?

SELECT ?Component

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string }

|  |
| --- |
| **Component** |
| RollingBearing\_1 |

**Consulta 17:** Com qual técnica de medição é monitorado o **componente\_1**?

SELECT ?Component ?Technique

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:isMonitoringWith ?Technique }

|  |  |
| --- | --- |
| **Component** | **Technique** |
| RollingBearing\_1 | VibrationAnalysis\_1 |

**Consulta 18:** Que grandeza usa a técnica\_1?

SELECT ?Component ?Technique ?Magnitude

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:isMonitoringWith ?Technique.

?Technique utfpr:useMagnitude ?Magnitude }

|  |  |  |
| --- | --- | --- |
| **Component** | **Technique** | **Magnitude** |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 |

**Consulta 19:** Qual é a unidade da Magnitude\_1?

SELECT ?Component ?Technique ?Magnitude ?Unit

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:isMonitoringWith ?Technique.

?Technique utfpr:useMagnitude ?Magnitude.

?Magnitude utfpr:hasUnit ?Unit}

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **Technique** | **Magnitude** | **Unit** |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 | "mm/s" |

**Consulta 20:** Qual tipo de coletor (transdutor) usa a técnica\_1?

SELECT ?Component ?Technique ?Magnitude ?Unit ?Transducer

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:isMonitoringWith ?Technique.

?Technique utfpr:useMagnitude ?Magnitude;

utfpr:useCollector ?Transducer.

?Magnitude utfpr:hasUnit ?Unit}

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **Technique** | **Magnitude** | **Unit** | **Transducer** |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 | "mm/s" | Accelerometer\_1 |

**Consulta 21:** Quantas medições são feitas no componente\_1, usando a técnica\_1?

SELECT ?Component ?Technique ?Magnitude ?Unit ?Transducer ?Measurement

WHERE {?Component utfpr:hasCode "6306\_C3"xsd:string;

utfpr:isMonitoringWith ?Technique.

?Technique utfpr:useMagnitude ?Magnitude;

utfpr:useCollector ?Transducer;

utfpr:hasMeasurementPoint ?Measurement.

?Magnitude utfpr:hasUnit ?Unit}

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Component** | **Technique** | **Magnitude** | **Unit** | **Transducer** | **Measurement** |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 | "mm/s" | Accelerometer\_1 | Measurement\_1 |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 | "mm/s" | Accelerometer\_1 | Measurement\_2 |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 | "mm/s" | Accelerometer\_1 | Measurement\_3 |

**Consulta 22:** Qual é a localização dessas medições no componente\_1?

SELECT ?Component ?Technique ?Magnitude ?Unit ?Transducer ?Measurement ?Location

WHERE {?Component utfpr:hasCode "6306\_C3"^^xsd:string;

utfpr:isMonitoringWith ?Technique;

utfpr:hasMeasurementPoint ?Measurement.

?Measurement utfpr:hasLocation ?Location.

?Technique utfpr:useMagnitude ?Magnitude;

utfpr:useCollector ?Transducer.

?Magnitude utfpr:hasUnit ?Unit }

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Component** | **Technique** | **Magnitude** | **Unit** | **Transducer** | **Measurement** | **Location** |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 | "mm/s" | Accelerometer\_1 | Measurement\_1 | "BOM0225\_003\_AC\_180\_R\_N" |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 | "mm/s" | Accelerometer\_1 | Measurement\_2 | "BOM0225\_003\_AC\_090\_R\_N" |
| RollingBearing\_1 | VibrationAnalysis\_1 | RMS\_Velocity\_1 | "mm/s" | Accelerometer\_1 | Measurement\_3 | "BOM0225\_003\_AC\_315\_A\_N" |

PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

PREFIX owl: <http://www.w3.org/2002/07/owl#>

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>

PREFIX utfpr: < [http://www.semanticweb.org/david/ontologies/2016/untitled-ontology-286#](http://www.semanticweb.org/david/ontologies/2016/untitled-ontology-286)>

**Consulta 23:** Quais são os grupos para avaliar zonas de limites?

SELECT ?Groups

WHERE {

?Groups rdf:type utfpr:GroupOfMachine }

|  |
| --- |
| **Groups** |
| Group\_1 |
| Group\_2 |
| Group\_3 |
| Group\_4 |

**Consulta 24:** Quase são as características de cada grupo?

SELECT ?Groups ?Features

WHERE {

?Groups utfpr:hasFeatures ?Features }

|  |  |
| --- | --- |
| **Groups** | **Features** |
| Group\_2 | "Machines with shaft heigh 160 mm <= H < 315 mm" |
| Group\_3 | "Used in pump machine with separate driver" |
| Group\_1 | "Macines with shaft heigt H >= 315 mm" |
| Group\_4 | "Used in pump machine with integrated driver" |
| Group\_3 | "Is a pump" |
| Group\_1 | "Machines with rated power: 300 kW < P < 50 MW" |
| Group\_4 | "Is a pump" |
| Group\_3 | "Machines with rated power: P > 15kW" |
| Group\_1 | "Is an electrical machine" |
| Group\_4 | "Machines with rated power: P > 15kW" |
| Group\_2 | "Is an electrical machine" |
| Group\_2 | "Machines with rated power: 15 kw < P <= 300 kW" |

Ordenar por ordem alfabético, segundo grupo

SELECT ?Groups ?Features

WHERE {

?Groups utfpr:hasFeatures ?Features }

ORDER BY ?Groups

|  |  |
| --- | --- |
| **Groups** | **Features** |
| Group\_1 | "Macines with shaft heigt H >= 315 mm" |
| Group\_1 | "Machines with rated power: 300 kW < P < 50 MW" |
| Group\_1 | "Is an electrical machine" |
| Group\_2 | "Machines with shaft heigh 160 mm <= H < 315 mm" |
| Group\_2 | "Is an electrical machine" |
| Group\_2 | "Machines with rated power: 15 kw < P <= 300 kW" |
| Group\_3 | "Used in pump machine with separate driver" |
| Group\_3 | "Used in pump machine" |
| Group\_3 | "Machines with rated power: P > 15kW" |
| Group\_4 | "Used in pump machine with integrated driver" |
| Group\_4 | "Used in pump machine" |
| Group\_4 | "Machines with rated power: P > 15kW" |

**Consulta 25:** Qual grupo avalia zonas de limites para máquinas “bomba”?

SELECT ?Groups ?Features

WHERE { ?Groups utfpr:hasFeatures ?Features

FILTER (?Features="Used in pump machine") }

|  |  |
| --- | --- |
| **Groups** | **Features** |
| Group\_3 | "Used in pump machine" |
| Group\_4 | "Used in pump machine" |

Outra forma

SELECT ?Groups ?Features

WHERE { ?Groups utfpr:hasFeatures ?Features;

utfpr:hasFeatures "Used in pump machine"^^xsd:string }

|  |  |
| --- | --- |
| **Groups** | **Features** |
| Group\_4 | "Used in pump machine with integrated driver" |
| Group\_4 | "Machines with rated power: P > 15kW" |
| Group\_4 | "Used in pump machine" |
| Group\_3 | "Used in pump machine with separate driver" |
| Group\_3 | "Used in pump machine" |
| Group\_3 | "Machines with rated power: P > 15kW" |

Filtrando a consulta até chegar ao grupo desejado

**Consulta 25:** Grupo que atenda a máquinas “bomba” com potência > 15kW

SELECT ?Groups ?Features

WHERE { ?Groups utfpr:hasFeatures ?Features;

utfpr:hasFeatures "Used in pump machine"^^xsd:string;

utfpr:hasFeatures "Machines with rated power: P > 15kW"^^xsd:string}

|  |  |
| --- | --- |
| **Groups** | **Features** |
| Group\_4 | ""Used in pump machine with integrated driver" |
| Group\_4 | "Machines with rated power: P > 15kW" |
| Group\_4 | "Used in pump machine" |
| Group\_3 | "Used in pump machine with separate driver" |
| Group\_3 | "Used in pump machine" |
| Group\_3 | "Machines with rated power: P > 15kW" |

**Consulta 25:** Grupo que atenda a máquinas “bomba” com potência > 15kW e que o sistema de acionamento (motor) seja separado

SELECT ?Groups ?Features

WHERE { ?Groups utfpr:hasFeatures ?Features;

utfpr:hasFeatures "Used in pump machine"^^xsd:string;

utfpr:hasFeatures "Machines with rated power: P > 15kW"^^xsd:string;

utfpr:hasFeatures "Used in pump machine with separate driver"^^xsd:string}

|  |  |
| --- | --- |
| **Groups** | **Features** |
| Group\_3 | "Used in pump machine" |
| Group\_3 | "Machines with rated power: P > 15kW" |
| Group\_3 | "Used in pump machine with separate driver" |