SafeMon NSO Data Pusher API

Document purpose

The purpose of this document is to describe the SafeMon NSO application programming interface (API). For measurement values, events and alarm objects from power grid substations and transformer stations. Substations are the last transformer in the power grid feeding industry and household voltage levels of 230V, 400V and 690V. Typically with an input voltage of 11000V or 22000V. The API is based on requirements and recommendations for substation instrumentation and monitoring as described in REN6025 v2.1. The API is uni-directional, meaning the data is being pushed from the SafeMon NSO back-end to third-party server/cloud. No action is required by the receiver in order for data to be pushed. The API is included as part of Software as a Service (SaaS) fee for SafeMon NSO.
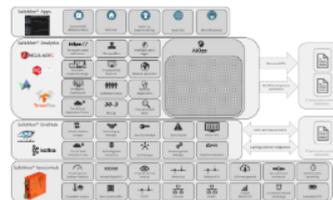
SafeMon NSO brief overview

SafeMon SensorHub RTU   Substation instrument/sensor preassemblies   SafeMon back-end and APIs   SafeMon NSO dashboard

Contact us

Please use support.energi@safebase.no for technical issues and suggestions on how we can do NSO even better.

Document status

SafeMon NSO Data Pusher API	Issued for third party acceptance	Frode Johansen fj@safebase.no
Document name	**Document status**	**Issued by**

Document change log

1.0b	05.12.2018	Added IO-event for IT-mains neutral point fuse (Nullpunktsikring/Nøytralpunktsavleder)
1.0a	01.12.2018	Added value, event and alarm attributes, descriptions and REN6025 references.
0.9a	14.11.2018	Added events and alarms. Added measured values for transformer oil temperature and room temperatures. Added null to describe object status.
Rev	**Date**	**Description**

Technical notes

SafeMon NAT IP:178.164.9.46

Third party http endpoint example:
https://someaddress.com/*gateway*/company=*companyname*&code=*authtoken*
gateway: SensorHub RTU installed physically in substation / transformer station

Data

The messages are sent by http, and contains values for each property, and their avg, min and max values. The list of all properties being sent can be found at the bottom of this document.

method: POST
body: JSON object with the following attributes

stationid	string	The id of the substation in the SafeMon databases.
deviceid	string	The id of the power analyzer in the SafeMon databases.
devicetype	string	The type of the device that the data is for.
companyid	string	A unique id for the company that the data belongs to.

companyname	string	The name of the company that the data belongs to.
values	Array<Object>	A list of value objects. The composition of a value object is described below.
events	Array<Object>	A list of event objects. The composition of an event object is described below.
alarms	Array<Object>	A list of alarm objects. The composition of an alarm object is described below.

Values object:

starttime	string	Start time of the values. The time is given as an ISO 8610 date time formatted string, including time zone.
endtime	string	End time of the values. The time is given as an ISO 8610 date time formatted string, including time zone.
[property]_avg	number	The average value between the start- and end time for the given property.
[property]_min	number	The minimum value between the start- and end time for the given property.
[property]_max	number	The maximum value between the start- and end time for the given property.
...		Avg, min and max are given for all properties.

Event object:
Events trigger when a certain property exceeds a set threshold, and clear up when the property no longer exceeds that threshold. Events are sent two times. First, when they trigger, and second, when they clear up. When the event is new, the endtime in the event object will be null. When the event is cleared, the endtime will have a set value. A list of common event types can be found at the bottom of this document.

starttime	string	Time when the event was triggered. The time is given as an ISO 8610 date time formatted string, including time zone.
endtime	string	Time when the event has ceased. The time is given as an ISO 8610 date time formatted string, including time zone.
type	string	The type of event tells something about what might have caused the event to be triggered.

property	string	The property that caused the event to be triggered.
triggervalue	number	The value that the property had when the event was triggered.

Alarm object:

Like events, alarms are sent twice. Once when they trigger, and once again when they are ceased. When an alarm is new, the endtime in the alarm object will be null. A list of all alarm types can be found at the bottom of this document.

starttime	string	Time when the alarm was triggered. The time is given as an ISO 8610 date time formatted string, including time zone.
endtime	string	Time when the alarm has ceased. The time is given as an ISO 8610 date time formatted string, including time zone.
type	string	The type of alarm tells something about what might have caused the alarm to be triggered.

Example messages

Poweranalyzer:

```
{
  "stationid": "416",
  "deviceid": "417",
  "devicetype": "poweranalyzer",
  "companyid": "1",
  "companyname": "SafeBase AS"
  "values": [
    {
      "starttime": "2018-03-13T15:00:00Z",
      "endtime": "2018-03-13T15:15:00Z",
      "vl1_avg": 232.59,
      "vl1_min": 232.10,
      "vl1_max": 232.90,
      "al1_avg": 23.57,
      "al1_min": 17.60,
      "al1_max": 34.40,
      "oil_temp_avg": null,
      "oil_temp_min": null,
      "oil_temp_max": null,
      ...
```

```
    }, {
        "starttime": "2018-03-13T15:15:00Z",
        "endtime": "2018-03-13T15:30:00Z",
        "vl1_avg": 230.59,
        "vl1_min": 230.10,
        "vl1_max": 230.90,
        "al1_avg": 22.51,
        "al1_min": 19.63,
        "al1_max": 32.01,
        "oil_temp_avg": null,
        "oil_temp_min": null,
        "oil_temp_max": null,
        ...
    }
],
"events": [
    {
        "starttime": "2018-03-14T15:01:30Z",
        "endtime": null,
        "type": "GroundFault",
        "property": "vl2",
        "triggervalue": 81.3
    }
],
"alarms": [
    {
        "starttime": "2018-03-14T15:01:30Z",
        "endtime": null,
        "type": "MoreThan25PercentGroundfaults"
    }, {
        "starttime": "2018-03-04T03:12:00Z",
        "endtime": "2018-03-13T22:08:30Z",
        "type": "MoreThan25PercentVoltageVariation"
    }
]
}
```

Environmental:

```
{
    "stationid": "416",
    "deviceid": "418",
    "devicetype": "environmental",
    "companyid": "1",
    "companyname": "SafeBase AS"
    "values": [],
```

```
"events": [
  {
    "starttime": "2018-03-13T03:12:00Z",
    "endtime": "2018-03-13T22:08:30Z",
    "type": "Timeout",
    "property": "timeout",
    "triggervalue": 68190
  }
],
"alarms": []
}
```

List of values being pushed by SafeMon NSO API:

Object name	Object type	Description	Unit	REN6025 v2.1 reference
vl1	value	Phase voltage L1 to N (TN mains type) or L1 to PE (IT mains type)	V	
vl2	value	Phase voltage L2 to N (TN mains type) or L2 to PE (IT mains type)	V	
vl3	value	Phase voltage L3 to N (TN mains type) or L3 to PE (IT mains type)	V	
al1	value	Current phase L1	A	
al2	value	Current phase L2	A	
al3	value	Current phase L3	A	
kw_l1	value	Active Power phase L1	kW	
kw_l2	value	Active Power phase L2	kW	
kw_l3	value	Active Power phase L3	kW	
kvar_l1	value	Reactive Power phase L1	kVAr	
kvar_l2	value	Reactive Power phase L2	kVAr	
kvar_l3	value	Reactive Power phase L3	kVAr	
kw_iii	value	Total Active Power all three phases L1, L2 and L3	kW	
pf_iii	value	Three-phase power factor . Ratio between fundamental harmonic three phase active power and apparent power.		9.5.8
freq	value	Frequency	Hz	
v12	value	Phase-to-phase voltage (line voltage) between L1 and L2	V	
v23	value	Phase-to-phase voltage (line voltage) between L2 and L3	V	
v31	value	Phase-to-phase voltage (line voltage) between L3 and L1	V	

thd_vl1	value	Total Harmonic Distortion Voltage phase L1	%	9.5.9
thd_vl2	value	Total Harmonic Distortion Voltage phase L2	%	9.5.9
thd_vl3	value	Total Harmonic Distortion Voltage phase L3	%	9.5.9
thd_al1	value	Total Harmonic Distortion Current phase L1	%	9.5.9
thd_al2	value	Total Harmonic Distortion Current phase L2	%	9.5.9
thd_al3	value	Total Harmonic Distortion Current phase L3	%	9.5.9
kva_iii	value	Apparent Power all three phases L1, L2 and L3	kVA	9.5.7
kvar_iii	value	Reactive power all three phases L1,L2, and L3	kVAr	9.5.7
a_avg_iii	value	Average phase current ((al1+al2+al3)/3)	A	
kva_l1	value	Apparent Power phase L1	kVA	9.5.6
kva_l2	value	Apparent Power phase L2	kVA	9.5.6
kva_l3	value	Apparent Power phase L3	kVA	9.5.6
pf_l1	value	Power factor phase L1. Ratio between fundamental harmonic active power (P) and apparent power (S) phase L1.		9.5.8
pf_l2	value	Power factor phase L2. Ratio between fundamental harmonic active power (P) and apparent power (S) phase L2.		9.5.8
pf_l3	value	Power factor phase L3. Ratio between fundamental harmonic active power (P) and apparent power (S) phase L3.		9.5.8
kvarl_iii	value	Inductive reactive power (all three phases)	kVAr	9.5.7
kvarc_iii	value	Capacitive reactive power (all three phases)	kVAr	9.5.7
cos_phi_iii	value	Power factor (all three phases)		9.5.8
kwh_iii	value	Active energy (all three phases)	kWh	9.5.6
kvah_iii	value	Reactive energy (all three phases)	kVAh	9.5.6
oil_temp	value	Transformer oil temperature	°C	10.5.1
room_temp	value	Room temperature	°C	10.5.2

Events

- **Event:** An event is created when an analog value is above and/or below a specified threshold value. An event is also created if a binary signal (0 or 1) is in a non-normal state. An example is oil temperature exceeding 90dgrC for more than 1 hour wait time. Or a dry contact detecting when a door is open or closed.
- **Wait time:** How many seconds the event must be triggered before an event is created/pushed. If wait time is 0 the event is pushed immediately. Wait time can be adjusted in for each event, or for all events. An example is overload on a transformer must be at 120% (threshold) for more than wait time 3600 seconds (1 hour) to trigger an event.
- **Trigger / threshold:** Threshold values can be adjusted individually for each substation, or common for all substations. Normally the threshold value is kept default for all substations.
- **Active by default:** Some events are activated by default when SafeMon NSO is installed. Other events must be customized by the super user(s) of the utility company.

List of event types:

Event name	Trigger / threshold	Attributes	Active by default	Wait time	Description	REN 6025 v.2.1 ref.
Timeout	No poweranalyzer (ex. CVM Mini) data received by backend		Yes	3600	No data from instrument (power analyzer)	10.2
Powerout	Power off SensorHub (RTU)	power_out	Yes	0	SensoHub power loss most likely due to power loss of substation	
LowEffect	>100% kVA load	kva_iii	No	3600	Transformer > 100% load	
HighEffect	>120% kVA load	kva_iii	No	3600	Transformer > 120% load	
GroundFault	IT-mains: Phase voltage outside threshold, default below 90V and above 170V.	vl1,vl2,vl3	Yes	0	Ground Fault / Earth fault: IT-mains: Phase voltage outside threshold, typically lower than 90V and higher than 170V. TT-mains: Leakage current above threshold.	9.3

GroundFault	TT/TN-mains: Leakage current above threshold value 200mA.	an				
PhaseVariation	1,5% for voltage, 30% for current	v12, v23, v31	No	60000	Ratio og line voltage / phase voltage	9.5.5
PhaseHigh	120%	vl1, vl2, vl3	No	0	Phase voltage above threshold value.	9.5.3
PhaseLow	60%	vl1, vl2, vl3	No	0	Phase voltage above threshold value.	9.5.3
CurrentLevelWarning	100%	al1, al2, al3	No	3600	Phase current above 100% for more than one hour	
CurrentLevelDanger	120%	al1, al2, al3	No	3600	Phase current above 120% for more than one hour	
VoltageBreak	5%	vl1, vl2, vl3	No	0	Phase voltage below threshold value. Will require battery backup on power analyzer.	9.5.3
ZeroPoint	Dry contact from neutral-point fuse (Nullpunktsikring/Nøytralpunktsavleder)	ioone, iotwo, iothree, iofour, iofive	No	0	IT-mains Nullpunktsikring	9.4
IO-SHO	Dry contact from short circuit indicator	ioone, iotwo, iothree, iofour, iofive	No	0	Digital input of SensorHub (RTU) is in a non-normal state. Non-normal state depend whether input is configured normally open or normally closed.	10.5.3
IO-DSK	Dry contact from door open/close indicator	ioone, iotwo, iothree, iofour, iofive	No	0	Digital input SensorHub from door open/close sensor	10.5.4
IO-VPG	Dry contact from water indicator	ioone, iotwo, iothree, iofour, iofive	No	0	Digital input SensorHub from water sensor	10.5.6
IO-BRN	Dry contact from fire/smoke detector	ioone, iotwo, iothree,	No	0	Digital input SensorHub from fire/smoke sensor	10.5.5.

		iofour, iofive				
IO-OSV	Dry contact from over voltage protection	ioone, iotwo, iothree, iofour, iofive	No	0	Digital input SensorHub from over voltage relay protection - high voltage	10.5.10
IO-BAT	Dry contact from battery/UPS	ioone, iotwo, iothree, iofour, iofive	No	0	Digital input SensorHub from battery/UPS	
ImageSurveillance	Movement detected by camera		No	0	Movement detected by installed camera	10.5.12

List of REN6025 alarm types:

Alarms are events filtered according to REN6025 v2.1 recommendations.
The purpose of the filter is to avoid too many alarms. An example is that a ground fault must be present more than 24 hours in order for an alarm is created.

Alarm name	Trigger / threshold	Active by default	Description	REN6025 v.2.1 reference
ActiveZeroPointOver24h	Dry contact input activated by NPS	Yes	NPS (Nøytralpunktsavleder) active for more than 24 hours.	10.2
ActiveGroundFaultOver24h	Phase voltage(s) (IT) or leakage current (TT/TN) outside threshold values	Yes	Earth fault active for more than 24 hours	10.2
MoreThan5GroundfaultsOver2h	Phase voltage(s) (IT) or leakage current (TT/TN) outside threshold values	Yes	5 earth faults lasting more than 2 hours last 7 days	10.2
MoreThan25PercentGroundfaults	Phase voltage(s) (IT) or leakage current (TT/TN) outside threshold values	Yes	Earth fault more than 25% of the time for the last 7 days	10.2
ActiveHighPhaseOver24h	Phase voltage above threshold value	Yes	Phase voltage(s) over limit for than 24 hours	10.3.3
ActiveLowPhaseOver24h	Phase voltage below threshold value	Yes	Phase voltage(s) below limit for than 24 hours	10.3.3
MoreThan25PercentHighPhase	Phase voltage above threshold value	Yes	Phase voltage(s) over limit more than 25% of the time for the last 7 days.	10.3.3
MoreThan25PercentLowPhase	Phase voltage below threshold value	Yes	Phase voltage(s) below limit more than 25% of the time for the last 7 days.	10.3.3
HasLongVoltageBreak	Phase voltage above threshold value	Yes	Voltage breaks lasting for more than 3 minutes during the last 7 days.	10.3.2
HasLongVoltageBreak	Phase voltage below threshold value	Yes	Voltage breaks lasting for more than 3 minutes during the last 7 days.	10.3.2