



LONMARK[®] Functional Profile: Boiler Controller

`SFPTboilerController`

NOTE: When time permits, this Profile will be modified to have the proper format.

Overview

This document describes the profile used for a Boiler controller which has self-contained hardware inputs and outputs for sensors and actuators such that it can provide stand-alone control functionality. The Boiler controller object is a network interface to the boiler controller, and can be used as an interface to a staged or a modulating boiler. A system controller could be used to command multiple modular boilers, each assigned a separate a Boiler controller object.

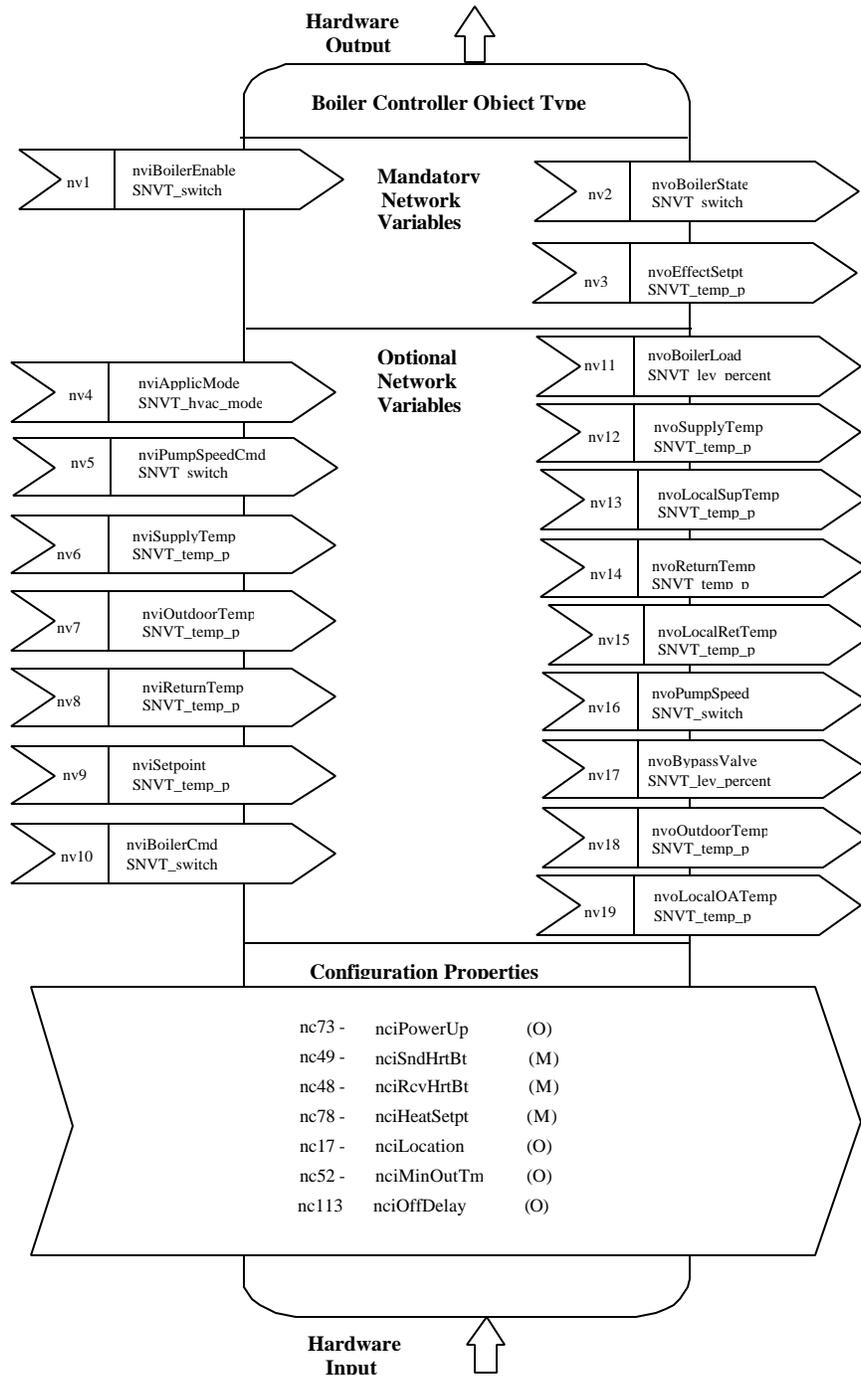
Network variable inputs request Boiler Operation and does not bypass internal safety limits.

Example Usage

The Boiler controller object interacts with one or more of the following LONMARK devices:

- supply/return temperature sensor node
- supervisory node (supplies heating setpoint or on/off/firing-rate)
- pump node
- other boiler controller nodes

Object Details



The Boiler controller object can control boiler, heating and pump outputs.

Boiler Controller Object Details

Table 1.1: Network Variable Inputs

NV # (M/O)*	NAME	Rcv Hrt Bt	SNVT Type	SNVT Index	Clas s	Description
1 (M)	nviBoilerEnable	No	SNVT_switch	95	Ram	Boiler Enable Input
4 (O)	nviApplicMode	Yes	SNVT_hvac_mode	108	Ram	Application Mode Input
5 (O)	nviPumpSpeedCmd	No	SNVT_switch	95	Ram	Pump Speed Command Input
6 (O)	nviSupplyTemp	Yes	SNVT_temp_p	105	Ram	Supply Temperature Input
7 (O)	nviOutdoorTemp	Yes	SNVT_temp_p	105	Ram	Outside Air Temperature Input
8 (O)	nviReturnTemp	Yes	SNVT_temp_p	105	Ram	Return Temperature Input
9 (O)	nviSetpoint	No	SNVT_temp_p	105	Ram	Temperature Setpoint Input (absolute)
10 (O)	nviBoilerCmd	Yes	SNVT_switch	95	Ram	Boiler Command Input

Table 1.2: Network Variable Outputs

NV # (M/O)*	NAME	Snd Hrt Bt	SNVT Type	SNVT Index	Default Service Type	Clas s	Description
2 (M)	nvoBoilerState	Yes	SNVT_switch	95	UNACKD	Ram	Boiler State Output
3 (M)	nvoEffectSetpt	Yes	SNVT_temp_p	105	UNACKD	Ram	Effective Setpoint Output
11 (O)	nvoBoilerLoad	Yes	SNVT_lev_percent	81	UNACKD	Ram	Boiler Load Output
12 (O)	nvoSupplyTemp	Yes	SNVT_temp_p	105	UNACKD	Ram	Supply Temperature Output
13 (O)	nvoLocalSupTemp	Yes	SNVT_temp_p	105	UNACKD	Ram	Local Supply Temperature Output
14 (O)	nvoReturnTemp	Yes	SNVT_temp_p	105	UNACKD	Ram	Return Temperature Output
15 (O)	nvoLocalRetTemp	Yes	SNVT_temp_p	105	UNACKD	Ram	Local Return Temperature Output
16 (O)	nvoPumpSpeed	Yes	SNVT_switch	95	UNACKD	Ram	Pump Speed Output
17 (O)	nvoBypassValve	Yes	SNVT_lev_percent	81	UNACKD	Ram	Bypass Valve Output
18 (O)	nvoOutdoorTemp	Yes	SNVT_temp_p	105	UNACKD	Ram	Outdoor Air Temperature Output
19 (O)	nvoLocalOATemp	Yes	SNVT_temp_p	105	UNACKD	Ram	Local Outdoor Air Temperature Output

Table 1.3: Configuration Properties

Config Propert y (M/O)*	NAME	SNVT Type	SNVT Index	Association	Description
73 (O)	nciPowerUp SCPTpwrUpState	SNVT_switch	95	Object	PowerUp Enable
49 (M)	nciSndHrtBt SCPTmaxSendTime	SNVT_time_sec	107	nv2(M), nv3(M), nv11(M), nv12(M), nv13(M), nv14(M), nv15(M), nv16(M), nv17(M), nv18(M), nv19(M)	Send Heartbeat
48 (O)	nciRcvHrtBt SCPTmaxRcvTime	SNVT_time_sec	107	nv4(M), nv6(M), nv7(M), nv8(M), nv10(M)	Receive Heartbeat
78 (M)	nciHeatSetpt SCPTheatSetpt	SNVT_temp_p	105	nv9(O)	Heating Setpoint
17 (O)	nciLocation SCPTlocation	SNVT_str_asc	36	Object	Location Label
52 (O)	nciMinOutTm SCPTminSendTime	SNVT_time_sec	107	nv2(O), nv3(O), nv11(O), nv12(O), nv13(O), nv14(O), nv15(O), nv16(O), nv17(O), nv18(O)	Minimum Send Time
113 (O)	nciOffDelay SCPTpumpDownDelay	SNVT_time_sec	107	nv1(O), nv5(O)	Off Delay Time

*M=mandatory, O=optional

Legend

Applic	Application
Bt	Beat
Cmd	Command
CW	Condenser Water
Effect	Effective
Hrt	Heart
M	Mandatory variable
Man	Manual
Max	Maximum
Min	Minimum
O	Optional variable
OA	Outdoor Air
Out	Output
Rcv	Receive
Ret	Return
Snd	Send
Sup	Supply
Temp	Temperature
Tm	Timer

Mandatory Network Variables - Inputs

Boiler Enable Input

```
network input SNVT_switch nviBoilerEnable;
```

This input is used to disable (stop) boiler operation, or to enable (automatic, local, or remote) boiler operation. This input is typically sent from a system coordination panel. For example, in a boiler control system, selected boilers would be disabled for an extended shutdown period until maintenance is performed. It is also possible to have a hardwired input to a boiler controller to be used for boiler enable. In instances where both a hardwired input and network input are present, the network variable has precedence over the physical input. The boiler controller can override this command when required for equipment protection. The boiler enable input may be overridden by a local hardwired control shutdown input to the boiler controller.

This input can be used for simple enable/disable functions, or can be used to enable a portion of the boiler's heat capacity. For example, if a boiler has 2 heat stages, a value of 100 (50.0%) could indicate that only one stage is enabled. The interpretation of values less than 100.0% is manufacturer-defined, based on the specific equipment and control algorithms used.

Valid Range

State	Value	Equivalent Percent	Boiler Operation
0	n/a	n/a	Disabled
1	0	0.0%	Disabled
1	1 to 199	0.5 to 99.5%	Partially Enabled
1	200 to 255	100.0%	Enabled
0xFF	n/a	n/a	Enabled (Invalid)

Default Value

The default value is manufacturer-defined. The boiler object may use the configuration value of nciPowerUp on power-up or restart. This network variable does not use the Receive Heartbeat.

Mandatory Network Variables - Outputs

Boiler State Output

```
network output SNVT_switch nvoBoilerState;
```

This output network variable reflects the boiler's present level of heat output, as well as the requested firing rate of a remote boiler. It can be used as part of a control loop and for monitoring purposes.

When used to report the status of a hardwired boiler controller, this output indicates the actual boiler state and firing rate. When used to control a remote boiler, this output indicates a requested boiler firing rate and state. For example, the nvoBoilerState could be used control an additional boiler controller object's firing rate by connection to the additional boiler object's nviBoilerCmd.

Valid Range

The valid Range is described below.

State	Value	Equivalent Percent	Actual or Requested Boiler State	Actual or Requested Firing Rate
0	n/a	n/a	OFF	n/a
1	1 to 199	0.5 to 100.0%	ON	Mfgr. Defined—See Note below.
1	200	100.0%	ON	High or 100%
0xFF	n/a	n/a	Invalid	Invalid

Note: This manufacturer defined actual or requested firing rate must be compatible with the input boiler command definitions for equipment interoperability.

When Transmitted

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

Update Rate

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

Default Service Type

The default service type is unacknowledged.

Effective Setpoint Output

```
network output SNVT_temp_p nvoEffectSetpt;
```

This output network variable is used to monitor the effective temperature setpoint which may depend on nciHeatSetpt, nviSetpoint, and any local setpoint adjustment.

Typical Range

The typical range is 0°C to 150°C.

When Transmitted

The variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

Update Rate

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

Default Service Type

The default service type is unacknowledged.

Optional Network Variables - Inputs

Application Mode Input

```
network input SNVT_hvac_mode nviApplicMode;
```

This network variable input is used to coordinate the Boiler controller node with any supervisory controller. If a mode is requested that is not supported by the unit controller, the unit controller will use a manufacturer-defined default mode.

`nviApplicMode` overrides the Heating mode of the boiler controller, unless `nviApplicMode` is HVAC_AUTO, HVAC_TEST, or HVAC_NUL, then the Boiler Controller Node determines the effective mode of the unit. If `nviApplicMode` is HVAC_TEST, then the effective mode is manufacturer-defined.

Valid Range

0 = HVAC_AUTO (Mode determined by unit)

1 = HVAC_HEAT (Use heat setpoints)

2 = HVAC_MRNG_WRMUP (Morning warm-up, manufacturer-defined) -

6 = HVAC_OFF (no unit operation allowed) - turn boiler off

7 = HVAC_TEST (Special test mode, manufacturer-defined) -

8 = HVAC_EMERG_HEAT (Emergency Heat, manufacturer-defined) – Cold climates typically require full heat for Air Handling systems during smoke-emergency conditions, requiring maximum boiler heat available.

0xFF = HVAC_NUL (same as HVAC_AUTO)

The other enumerations provided by `SNVT_hvac_mode` are optional.

Default Value

The default value is HVAC_AUTO. This value will be adopted at power-up and in the case of not receiving an update within the specified receive heartbeat time.

Pump Speed Command Input

```
network input SNVT_switch nviPumpSpeedCmd;
```

This input network variable is used to connect an external pump control to the node or to allow any supervisory device to override the pump speed controlled by the node's control algorithm. The boiler controller can override this command when required for equipment protection. Pump command to off may be delayed by `nciOffDelay`. This command may be interlocked with the boiler operation (manufacturer defined). This input can be used with 1-speed, 2-speed, 3-speed, n-speed and variable-speed pumps.

Valid Range

The valid range is the range provided by `SNVT_switch` as described below:

1-speed Pump

State	Value	Equivalent Percent	Requested Speed
0	n/a	n/a	OFF
1	0	0%	OFF
1	1 to 200	0.5 to 100.0%	ON
1	201 to 255	100.0%	ON
0xFF	n/a	n/a	AUTO

2-speed Pump

State	Value	Equivalent Percent	Requested Speed
0	n/a	n/a	OFF
1	0	0%	OFF
1	1 to 100	0.5 to 50.0%	1
1	101 to 200	50.5 to 100.0%	2
1	201 to 255	100.0%	2
0xFF	n/a	n/a	AUTO

3-speed Pump

State	Value	Equivalent Percent	Requested Speed
0	n/a	n/a	OFF
1	0	0%	OFF
1	1 to 66	0.5 to 33.0%	1
1	67 to 133	33.5 to 66.5%	2
1	134 to 200	67.0 to 100.0%	3
1	201 to 255	100.0%	3
0xFF	n/a	n/a	AUTO

Variable-speed Pump

State	Value	Equivalent	Requested
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		Percent	Speed
0	n/a	n/a	OFF
1	0	0%	OFF
1	1 to 200	0.5 to 100.0%	0.5 to 100.0%
1	201 to 255	100.0%	100.0%
0xFF	n/a	n/a	AUTO

n-speed Pump

State	Value	Equivalent Percent	Requested Speed
0	n/a	n/a	OFF
1	0	0%	OFF
1	1 to (1/n)200	0.5 to (1/n)100%	Fan speed #1
1	1+(1/n)200 to (2/n)200	0.5+(1/n)100 to (2/n)100%	Fan speed #2
1	1+((m-1)/n)200 to (m/n)200	0.5+((m-1)/n)100 to (m/n)100%	Fan speed #m
1	1+((n-1)/n)200 to 200	0.5+((n-1)/n)100 to 100%	Fan speed #n
0xFF	n/a	n/a	AUTO

Default Value

The default value is AUTO (state=0xFF). This value will be adopted at power-up. This network variable does not use the Receive Heartbeat.

Supply Temperature Input

```
network input SNVT_temp_p nviSupplyTemp;
```

This input network variable is used to connect an external supply temperature sensor to the node. It does not have to be bound to a sensor node if the Boiler Controller node itself provides a locally wired supply temperature sensor. In any case, the nviSupplyTemp has priority if a valid value is present.

Valid Range

The valid range is 0°C to 150°C. The value 0x7FFF(=+327.67°C) will be handled as an invalid value.

Default Value

Default Value is 0x7FFF(=+327.67°C). This value will be adopted at power-up and in case of not receiving an update within the specified receive heartbeat time.

Outdoor Air Temperature Input

```
network input SNVT_temp_p nviOutdoorTemp;
```

This input network variable represents information from an outdoor air temperature sensor. This value is typically generated from either a communicating sensor or a supervisory controller. The unit may also have a locally wired outdoor air temperature sensor. Valid values of `nviOutdoorTemp` have priority over local sensor values.

Valid Range

The valid range is -40°C to 50°C. The value `0x7FFF` = +327.67°C will be handled as an invalid value in case of a sensor failure.

Default Value

Default Value is `0x7FFF` (= +327.67°C). This value will be adopted at power-up and in case of not receiving an update within the specified receive heartbeat time.

Boiler Return Temperature Input

```
network input SNVT_temp_p nviReturnTemp;
```

This input network variable is used to connect an external return temperature sensor to the node. It does not have to be bound to a sensor node if the Boiler Controller node itself provides a locally wired space temperature sensor. In any case, the `nviReturnTemp` has priority if a valid value is present.

Valid Range

The valid range is 0°C to 150°C. The value `0x7FFF`=+327.67°C will be handled as an invalid value.

Default Value

Default Value is `0x7FFF` (=+327.67°C). This value will be adopted at power-up and in case of not receiving an update within the specified receive heartbeat time.

Temperature Setpoint Input (absolute)

```
network input SNVT_temp_p nviSetpoint;
```

This input network variable is used to allow the heating setpoint for the boiler water temperature to be changed via the network. If a valid value is not present, either a locally wired setpoint knob or the setpoint as configured in `nciHeatSetpt` will be used.

Valid Range

The valid range is 0°C to 150°C. The value `0x7FFF`=+327.67°C will be handled as an invalid value.

Default Value

Default Value is 0x7FFF (= +327.67°C). This value will be adopted at power-up. This network variable input does not use the Receive Heartbeat function. When the default value is in effect, the Boiler Controller will use the configuration property `nciHeatSetpt`.

Boiler Command Input

```
network input SNVT_switch nviBoilerCmd;
```

This input network variable is used to command the boiler state and firing rate of the Boiler controller object (e.g. to disable the boiler, or allow automatic control), or to allow any supervisory device (e.g. lead/lag control schemes for multiple modular boilers) to override the boiler state and firing rate controlled by the node's control algorithm. The Boiler controller can override this command when required for equipment protection. On a variable firing rate boiler, the lowest commanded speed (0.5%) may operate at either the minimum firing rate (which will be greater than 0.5% of the total heat capacity for a gas boiler), or at 0.5 percent of the total heat capacity of the boiler (for an electric boiler). This input can be used with 1-state (On/Off), 2-state(Off/Low/High), 3-state(Off/Low/Medium/High), n-state and variable (0 to 100%) firing rate boilers.

Valid Range

The valid Range is described below:

On/Off Boiler

State	Value	Equivalent Percent	Requested Boiler State	Requested Firing Rate
0	n/a	n/a	OFF	OFF
1	0	0%	OFF	OFF
1	1 to 200	0.5 to 100.0%	ON	ON
1	201 to 255	100.0%	ON	ON
0xFF	n/a	n/a	AUTO	AUTO

2-State Firing Rate Boiler

State	Value	Equivalent Percent	Requested Boiler State	Requested Firing Rate
0	n/a	n/a	OFF	OFF
1	0	0%	OFF	OFF

1	1 to 100	0.5 to 50.0%	ON	LOW FIRE
1	101 to 200	50.5 to 100.0%	ON	HIGH FIRE
1	201 to 255	100.0%	ON	HIGH FIRE
0xFF	n/a	n/a	AUTO	AUTO

3-State Firing Rate Boiler

State	Value	Equivalent Percent	Requested Boiler State	Requested Firing Rate
0	n/a	n/a	OFF	OFF
1	0	0%	OFF	OFF
1	1 to 66	0.5 to 33.0%	ON	LOW FIRE
1	67 to 133	33.5 to 66.5%	ON	MEDIUM FIRE
1	134 to 200	67.0 to 100.0%	ON	HIGH FIRE
1	201 to 255	100.0%	ON	HIGH FIRE
0xFF	n/a	n/a	AUTO	AUTO

Variable-Firing Rate Boiler

State	Value	Equivalent Percent	Requested Boiler State	Requested Firing Rate
0	n/a	n/a	OFF	OFF
1	0	0%	OFF	OFF
1	1 to 200	0.5 to 100.0%	ON	0.5 to 100.0%
1	201 to 255	100.0%	ON	100.0%
0xFF	n/a	n/a	AUTO	AUTO

n-State Firing Rate Boiler

State	Value	Equivalent Percent	Requested Boiler State	Requested Firing Rate
0	n/a	n/a	OFF	OFF
1	0	0%	OFF	OFF
1	1 to $(1/n)200$	0.5 to $(1/n)100\%$	ON	Firing Rate #1
1	$1+(1/n)200$ to $(2/n)200$	$0.5+(1/n)100$ to $(2/n)100\%$	ON	Firing Rate #2
1	$1+((m-1)/n)200$ to $(m/n)200$	$0.5+((m-1)/n)100$ to $(m/n)100\%$	ON	Firing Rate

				#m
1	$1 + ((n-1)/n)200$ to 200	$0.5 + ((n-1)/n)100$ to 100%	ON	Firing Rate #n
0xFF	n/a	n/a	AUTO	AUTO

OFF: The boiler should be switched off.
ON: The boiler should be switched on.
AUTO: The boiler is not controlled by the nviBoilerCmd. The boiler control is determined by the local control algorithm.

Default Value

Default Value is Auto (State = 0xFF). This value will be adopted at power-up and in case of not receiving an update within the specified receive heartbeat time.

Optional Network Variables - Outputs

Boiler Load Output

```
network output SNVT_lev_percent nvoBoilerLoad;
```

This output indicates the current heat/cool energy demand of the unit. Negative values indicate that heating energy is required (or in use) by the boiler controller.

The actual determination of the value of nvoBoilerLoad is manufacturer-defined. One typical method is to report the output of the heating/cooling control algorithm. This value can be used for coordination within the HVAC subsystem and energy management decisions made by supervisory nodes or other control equipment.

Typical Range

The valid Range is -163.835% to 0%. The value 0x7FFF=+163.84% will be handled as an invalid value.

When Transmitted

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

Update Rate

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

Default Service Type

The default service type is unacknowledged.

Supply Temperature Output

```
network output SNVT_temp_p nvoSupplyTemp;
```

This output network variable is used to monitor the supply water temperature that the Boiler Controller is using for control. If the input `nviSupplyTemp` has a valid value, this output will echo the value of the input. If a valid value for `nviSupplyTemp` does not exist, the locally wired sensor value is used. If neither value is available, the output will send the invalid value.

Typical Range

The typical range is 0°C to 150°C. The value `0x7FFF`=+327.67°C will be used as an invalid value in case of a sensor failure.

When Transmitted

The variable is transmitted immediately when its value has changed significantly (manufacturer defined). Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (`nciSndHrtBt`) configuration value.

Update Rate

This value will be updated no faster than the Minimum Send Time (`nciMinOutTm`) configuration value, if used (manufacturer-defined).

Default Service Type

The default service type is unacknowledged.

Local Supply Temperature Output

```
network output SNVT_temp_p nvoLocalSupTemp;
```

This output network variable indicates the value of a locally wired supply water temperature sensor.

Typical Range

The typical range is -40°C to 70°C. The value `0x7FFF` = +327.67°C will be handled as an invalid value in case of a sensor failure.

When Transmitted

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (`nciSndHrtBt`) configuration value.

Update Rate

This value will be updated no faster than the Minimum Send Time (`nciMinOutTm`) configuration value, if used (manufacturer-defined).

Default Service Type

The default service type is unacknowledged.

Return Temperature Output

```
network output SNVT_temp_p nvoReturnTemp;
```

This output network variable is used to monitor the return water temperature that the Boiler Controller is using for control. If the input `nviReturnTemp` has a valid value, this output will echo the value of the input. If a valid value for `nviReturnTemp` does not exist, the locally wired sensor value is used. If neither value is available, the output will send the invalid value.

Typical Range

The typical range is 0°C to 150°C. The value `0x7FFF`=+327.67°C will be used as an invalid value in case of a sensor failure.

When Transmitted

The variable is transmitted immediately when its value has changed significantly (manufacturer defined). Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (`nciSndHrtBt`) configuration value.

Update Rate

This value will be updated no faster than the Minimum Send Time (`nciMinOutTm`) configuration value, if used (manufacturer-defined).

Default Service Type

The default service type is unacknowledged.

Local Return Temperature Output

```
network output SNVT_temp_p nvoLocalRetTemp;
```

This output network variable indicates the value of a locally wired return water temperature sensor.

Typical Range

The typical range is -40°C to 70°C. The value `0x7FFF` = +327.67°C will be handled as an invalid value in case of a sensor failure.

When Transmitted

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (`nciSndHrtBt`) configuration value.

Update Rate

This value will be updated no faster than the Minimum Send Time (`nciMinOutTm`) configuration value, if used (manufacturer-defined).

Default Service Type

The default service type is unacknowledged.

Pump Speed Output

```
network output SNVT_switch nvoPumpSpeed;
```

This output network variable reflects the actual pump speed of a local multi-speed pump as well as the requested speed of a remote pump. It can be used as part of a control loop and for monitoring purposes. When used to control a remote pump, this output indicates a requested pump speed. When used to report the status of a hardwired pump output(s), this output indicates the actual pump speed.

Typical Range

The valid range is described below:

State	Value	Equivalent Percent	Actual or Requested Pump State	Actual or Requested Pump Speed
0	n/a	n/a	OFF	n/a
1	1 to 199	0.5 to 100.0%	ON	Mfgr. Defined – see Note below
1	200	100.0%	ON	High or 100%
0xFF	n/a	n/a	Invalid	Invalid

Note: This manufacturer defined actual or requested pump speed must be compatible with the input pump speed command definitions for equipment interoperability.

When Transmitted

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

Update Rate

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

Default Service Type

The default service type is unacknowledged.

Bypass Valve Output

```
network output SNVT_lev_percent nvoBypassValve;
```

This output network variable reflects the current value of the bypass control valve position (if hardwired) or can be used to control a remote bypass valve for this particular boiler controller object. The bypass valve controls the feedback of hot water directly from the supply water to the heat exchanger to be mixed with return water. Low temperature water may cause corrosive condensation in the

heat exchanger. This control is not intended to be used for supply or system water loop temperature control.

Valid Range

The valid range is 0% to 100% of primary heat capacity. The value 0x7FFF = +163.835 % will be sent as an invalid value to indicate that no primary heat is used.

When Transmitted

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

Update Rate

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

Default Service Type

The default service type is unacknowledged.

Outdoor Air Temperature Output

```
network output SNVT_temp_p nvoOutdoorTemp;
```

This output network variable is used to monitor the outdoor air temperature that the Boiler Controller is using for control. If the input nviOutdoorTemp has a valid value, this output will echo the value of the input. If a valid value for nviOutdoorTemp does not exist, the locally wired sensor value is used. If neither value is available, the output will send the invalid value.

Typical Range

The typical range is -40°C to 70°C. The value 0x7FFF = +327.67°C will be handled as an invalid value in case of a sensor failure.

When Transmitted

This variable is transmitted immediately when its value has changed significantly (manufacturer defined). Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

Update Rate

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

Default Service Type

The default service type is unacknowledged.

Local Outdoor Air Temperature Output

network output SNVT_temp_p nvoLocalOATemp;

This output network variable indicates the value of a locally wired Outdoor Air Temperature sensor.

Typical Range

The typical range is -40°C to 70°C. The value 0x7FFF = +327.67°C will be handled as an invalid value in case of a sensor failure.

When Transmitted

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

Update Rate

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

Default Service Type

The default service type is unacknowledged.

Mandatory Configuration Properties

Send Heartbeat

```
network input config SNVT_time_sec nciSndHrtBt;
```

This configuration property defines the maximum period of time that expires before the specified network variable outputs will automatically be updated. The specific method for sending heartbeat updates is manufacturer-defined.

Network variable outputs can be defined in 2 categories for the use of send heartbeat, based upon whether they are specified for send heartbeat in the Network Variable Outputs Table, as shown below:

Network Variable Output	Specified for Send Heartbeat in Table?	Result: Use Send Heartbeat?
Category 1	Yes	Yes
Category 2	No	Manufacturer-defined

Valid Range

The valid range is any value between 0.0 sec and 6,553.4 sec. Setting `nciSndHrtBt = 0.0` disables the Send Heartbeat mechanism.

Typical Default Value

0 (no automatic update)

SCPT Reference

SCPTmaxSendTime (#49)

Heat Setpoint

```
network input config SNVT_temp_p nciHeatSetpt;
```

This configuration property defines the boiler temperature setpoint. The heat setpoint is a default, which can be modified by various input variables, such as `nviSetpoint`.

Typical Range and Default Values

	Minimum	Maximum	Default
boiler setpoint	0°C	150°C	35 °C

SCPT Reference

SCPTHeatSetpt(#78)

Optional Configuration Properties

Power Up Enable

```
network input config SNVT_switch nciPowerUp;
```

This input configuration network variable provides the default power-up and restart modes of the boiler controller. This input configuration variable can be used to disable (stop) boiler operation, to enable (automatic, local, or remote control) boiler operation, or to enable a portion of the boiler's heat capacity. For example, in a boiler control system, selected boilers could be disabled for an extended shutdown period until maintenance is performed. If an individual boiler has 2 heat stages, a value of 100 (50.0%) could indicate that only one stage is enabled. The interpretation of values less than 100.0% is manufacturer-defined, based on the specific equipment and control algorithms used.

Valid Range

State	Value	Equivalent Percent	Compressor Operation
0	n/a	n/a	Disabled
1	0	0.0%	Disabled
1	1 to 199	0.5 to 99.5%	Partially Enabled
1	200 to 255	100.0%	Enabled
0xFF	n/a	n/a	Enabled (Invalid)

Default Value

The default value is State = 0 , Value = 0 (0.0%). The boiler object may use the configuration value of nciPowerUp on power-up or restart (manufacturer-defined).

SCPT Reference

SCPTpwrUpState (#73)

Receive Heartbeat

```
network input config SNVT_time_sec nciRcvHrtBt;
```

This configuration property is used to control the maximum time that elapses after the last update to a specified network variable input before the Boiler Controller starts to use its default values. Network variable inputs can be defined in 3 categories for use of receive heartbeat, based upon whether they are specified for receive heartbeat in the Network Variable Inputs Table and whether they are bound, as shown below:

Network Variable Input	Specified for Receive Heartbeat in Table?	Bound?	Result: Use Receive Heartbeat?
Category 1	Yes	Yes	Yes
Category 2	Yes	No	Manufacturer-defined
Category 3	No	Don't Care	No

Valid Range

The valid range is any value between 0.0 sec and 6,553.4 sec. Setting `nciRcvHrtBt = 0.0` disables the Receive Heartbeat mechanism.

Typical Default Value

0 (no failure detect)

SCPT Reference

SCPTmaxRcvTime (#48)

Location Label

```
network input config SNVT_str_asc nciLocation;
```

This configuration property can optionally be used to provide more descriptive physical location information than can be provided by the Neuron Chip's 6-byte location string. The location relates to the object and not to the node.

Valid Range

Any NULL terminated ASCII string of 31 bytes total length.

Typical Default Value

The typical default value is an ASCII string containing all zeros (“\0”).

SCPT Reference

SCPTlocation (#17)

Minimum Send Time

```
network input config SNVT_time_sec nciMinOutTm;
```

This configuration property defines the minimum period of time between automatic network variable output transmissions. The specific use of `nciMinOutTm` is manufacturer-defined. For example, it can be applied to some network variable outputs (such as sensor values) but not to all network variable outputs.

Although this configuration property is optional, it must be provided if the minimum send time function is used in the controller. If this configuration property is not present, the controller cannot use the minimum send time function.

Valid Range

The valid range is any value between 0.0 sec and 6,553.4 sec. Setting `nciMinOutTm = 0.0` disables the Minimum Send Time mechanism.

Typical Default Value

0 (no minimum send time)

SCPT Reference

SCPTminSendTime (#52)

Off Delay Time

```
network input config SNVT_time_sec nciOffDelay;
```

This configuration property is used to control the time delay that the pump remains on after a new command to turn the pump off is issued. The boiler controller can override this command when required for equipment protection. The configuration property may be used by enable/disable boiler commands, manual pump speed command, or algorithm pump control to delay turning off the water pump after a call for heat is satisfied.

Valid Range

The valid range is any value between 0.0 sec and 65553.4 sec. Setting `nciOffDelay = 0.0` disables the Off Delay mechanism.

Typical Default Value

0 (disable the Off Delay mechanism)

SCPT Reference

SCPTpumpDownDelay (#113)

Additional Considerations

None specified.

Proposed New SCPTs

The following proposed new SCPTs are used in this profile.

Configuration Property	Standard Configuration Parameter Type (SCPT)	Equivalent SNVT (SNVT Index)	SCPT Index
Power Up Behavior refer to current "Chiller Enable"	SCPTPowerUp Change Request for current "SCPTChillerEnable"	SNVT_switch	#73

Change History

Revision 0.01 (October 28, 1998)

1. Incomplete Initial Draft

Revision 0.02 (December 10, 1998)

1. add nviApplicMode;
2. rename nvoOnOff into nvoBoilerState;
3. rename nviBlrCmd into nviBoilerCmd;
4. rename nvoPumpCmd into nvoPumpState;
5. rename nvoBypass into nvoValveOvrd;
6. remove nviCapacityLim;
7. nviBoilerCmd and nviPumpCmd based on nciRcvHrtBt;
8. make nvoBoilerLoad consistent to other HVAC Profile's nvoTerminalLoad;
9. nviOATemp: extended by INVALID value and priority between local sensor and nvi.
10. remove nciMode;
11. add nciLocation;
12. replace nciBoilerEnable by nciPowerUp (LonMark Request for Change: rename SCPTChillerEnable into SCPTPowerUp SCPT index #73);
13. rechecked all Network Variables and Network Configurations for consistency with Space Comfort Controller Template Version 1.0 and made appropriate changes.
14. Added Minimum Send Time (nciMinOutTm) optional configuration property.

Revision 0.03 (February 11, 1999)

1. Incorporate comments from Gene Shedivy (The Trane Co.):
 - a) Overview: remove "The Boiler object is used to control water temperature by ...";
 - b) Change "flow temperature sensor" into "temperature sensor";
 - c) Network Variable tables match heading of the corresponding sections;
 - d) Remove all "Space Comfort Controller" references for the nv's;
 - e) Correct incorrect references in section nvoReturnTemp;
 - f) Rename nvoValveOvrd into nvoValveState;
2. nciRcvHrtBt became mandatory;

Revision 0.04 (May 13, 1999)

1. Incorporate comments from Phil Daniell (Johnson Controls):

- a) Overview:Removed “BLR” and replace with Boiler
 - b) Overview:Reworded to say Boiler Object is a network interface to the boiler controller.
 - c) Overview:Renamed modulating valve to bypass valve.
 - d) Object Details:Added Hardware Inputs Tag to bottom drawing.
 - e) Network Variable Tables: Changed Description text to match the text heading under each network variable description.
 - f) Added nviBoilerEnable. No Heartbeat necessary. Allows boiler operation to be disabled (off) or enabled (local, automatic, or remote control). Default value is derived from nciPwrUp.
 - g) nviBoilerCmd: Reword to indicate Value is firing rate. Add a table for “n” Firing rates. Reword document to low-high firing rate instead of stage 1 , stage 2, etc. Remove reference to Manual command and override. Remove “doesn’t have to be bound” sentence. Made Optional NV
 - h) nviApplicMode: remove morning warm action, replace with manufacturer defined. Remove comments in HVAC_emergency state –replace with manufacturer defined. Made other states optional.
 - i) nviPumpCmd: changed Off command may be interlocked with the boiler (manufacturer defined). Added nciOffDelay Command. Removed Heartbeat. : rename nviPumpState to nviPumpSpeedCmd
 - j) nvoBoilerLoad: Change text description to convey a clear meaning.
 - k) nvoReturnTemp: remove incorrect text reference to nvoReturnTemp, changed to nviReturnTemp.
 - l) nvoPumpState: renamed nvoPumpState to nvoPumpSpeed.
 - m) Rename nvoValveState into nvoBypassValve; Wording changed to indicate this is the bypass position
 - n) nciPowerUp: updated to maintain consistency with nviBoilerEnable.
 - o) nciHeatSetpt now mandatory.
 - p) Updated order of text and changed name of nvi/nvoOATemp to nvi/nvoOutdoorTemp.
2. added nciOffDelay per comment f) above;

Revision 0.05 (September 13, 1999)

- 1. Incorporate comments from Lonmark committee:
 - a) Added local optional local sensors for Outdoor Temp, Supply and Return water.
 - b) Reformated Header/Footer , table numbers, font
 - c) Removed generic BLR object diagram by Overview section.
 - d) Added Legend for abbreviations in NVs.
 - e) Reworded “boiler” to “boiler controller” for object, nv, and title references.
 - f) Updated object details and NV names to correct nv names to 16 character limit: nvoLocalSupTemp, nvoLocalRetTemp.
 - g) Added note that Value field for nvoBoilerState and nvoPumpSpeed is “Manufacturer Defined” but must be compatible with the nviBoilerCmd and nviPumpSpeedCmd command definitions for equipment interoperability.
 - h) Correct the definition of nvoOutdoorTemp to be consistent with nvoSupplyTemp and nvoReturnTemp. The output is nviOutdoorTemp or the hardware input.