[EnergyPlus_Support] Question about how to set 90.1 baseline pump in Energyplus

8 messages

Jenny Zhang <jenny.zhang@arup.com>
Reply-To: EnergyPlus_Support@yahoogroups.com
To: "EnergyPlus_Support@yahoogroups.com" <EnergyPlus_Support@yahoogroups.com>

Sat, May 4, 2013 at 11:46 AM

Hi All friends

I have questions about how to set 90.1 baseline pumps in E+

1) The condense water pumps

90.1 G3.1.3.11 states that Each chiller shall be modeled with separate condenser water and chilled-water pumps interlocked to operate with the associated chiller.

For chilled water pumps it is easy to solved, because we could set CHW pumps in each chiller chilled water branch and of course the chilled water pump will run only the chiller run; but for condenser water pumps I face the problem that I could put cw pumps in chiller condenser water-side branch.

Does E+ requires condenser water pumps to be put only on the condenser water branch?

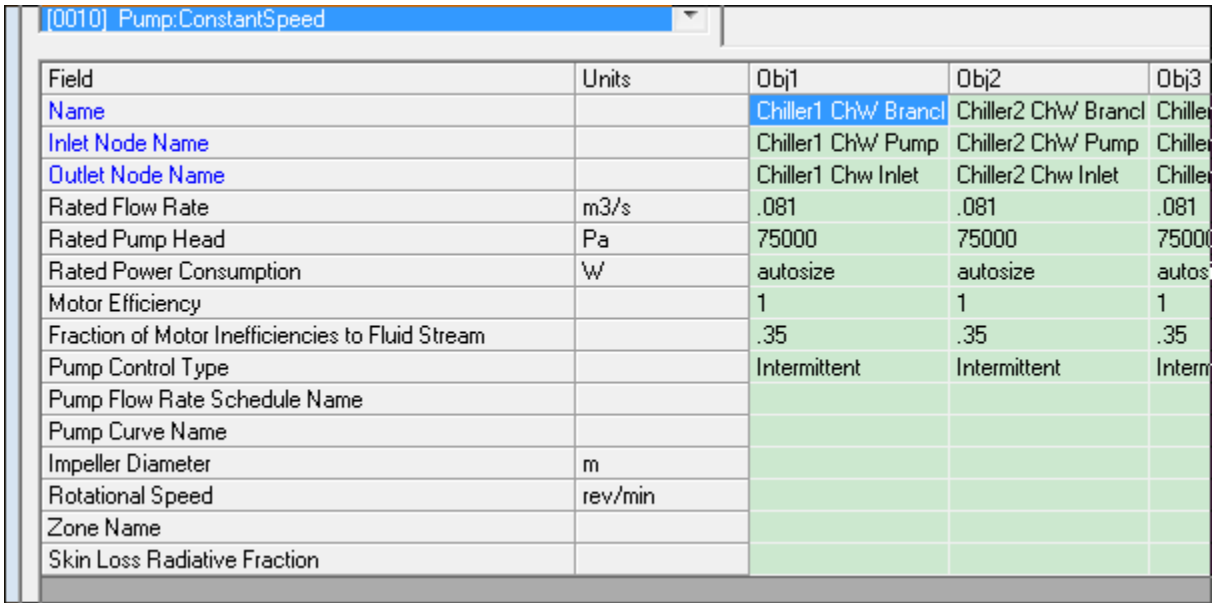
I think there is two way to do the setting: (1) set headed pumps in the cw supply side branch or (2) set more than one cw tower(same as chiller nos) and for each cw tower put a condenser water pump in the branch.

Which is better? Or Do you have other method?

2) Pump power

90.1requries pump power for chilled water/hot water/condenser water pumps. How to set it? In eQuest usually I use pump head & total efficiency to ensure the power/flow rate(such as 75ft&65% =22W/gpm),

But in E+ I find it difficult to do the same setting. Only motor efficiency can be input, and how about pump efficiency? Is it 78%, I find in the EngineeringReference.pdf “The motor efficiency is an input. Since we need the total efficiency to calculate the nominal power consumption we assume an impeller efficiency of 0,78 for purposes of sizing”. Does it means that the total efficiency is motor efficiency* 0.78 or we can use “Fraction of motor inefficiencies to fluid stream” to control the total efficiency? I really confused.



[0010] Pump:ConstantSpeed

Field	Units	Obj1	Obj2	Obj3
Name		Chiller1 ChW Brancl	Chiller2 ChW Brancl	Chille
Inlet Node Name		Chiller1 ChW Pump	Chiller2 ChW Pump	Chille
Outlet Node Name		Chiller1 Chw Inlet	Chiller2 Chw Inlet	Chille
Rated Flow Rate	m3/s	.081	.081	.081
Rated Pump Head	Pa	75000	75000	7500(
Rated Power Consumption	W	autosize	autosize	autos
Motor Efficiency		1	1	1
Fraction of Motor Inefficiencies to Fluid Stream		.35	.35	.35
Pump Control Type		Intermittent	Intermittent	Interm
Pump Flow Rate Schedule Name				
Pump Curve Name				
Impeller Diameter	m			
Rotational Speed	rev/min			
Zone Name				
Skin Loss Radiative Fraction				

Many thanks!

Best Regards

Jenny Zhang

Assistant Engineer | Building Sustainability

Arup

39/F-41/F Huaihai Plaza 1045 Huaihai Road (M), Shanghai 200031, China

t +86 21 3118 8888 **d** +86 21 3118 8750

f +86 21 3118 8882

www.arup.com

__.-._.-.__

Primary EnergyPlus support is found at:
http://energyplus.helpserve.com or send a message to energyplus-support@gard.com

The primary EnergyPlus web site is found at:
http://www.energyplus.gov

The group web site is:
http://groups.yahoo.com/group/EnergyPlus_Support/

Attachments are currently allowed but be mindful that not everyone has a high speed connection. Limit attachments to small files.

EnergyPlus Documentation is searchable. Open EPlusMainMenu.pdf under the Documentation link and press the "search" button.

__,_._,___

Jim Dirkes <jim@buildingperformanceteam.com>
Reply-To: EnergyPlus_Support@yahoogroups.com
To: "EnergyPlus_Support@yahoogroups.com" <EnergyPlus_Support@yahoogroups.com>

Jenny,

Your question #2:

I think E+ follows much the same logic as you describe for eQuest. It is also easy to test by using different values of motor efficiency to find the re

The method below shows a derivation for US (IP) units of the necessary pump pressure rise to satisfy ASHRAE 90.1. You will notice in the very la motor, but you can easily adjust the formulae for the actual motor efficiency.

Pump Power (90.1 Limitation)

US measure:

Watts =

Watts =

GPM

James V Dirkes II, PE, BEMP, LEED AP
www.buildingperformanceteam.com
Energy Analysis, Commissioning & Training Services
1631 Acacia Drive, Grand Rapids, MI 49504 USA
616 450 8653

From: EnergyPlus_Support@yahoogroups.com [mailto:EnergyPlus_Support@yahoogroups.com] **On Behalf Of** Jenny Zhang
Sent: Saturday, May 04, 2013 5:46 AM
To: 'EnergyPlus_Support@yahoogroups.com'
Subject: [EnergyPlus_Support] Question about how to set 90.1 baseline pump in Energyplus

[Quoted text hidden]

__._,_._____

YAHOO! GROUPS

__,_._,___

---

patrick_bivona <patrick.bivona@gmail.com> Sun, May 5, 2013 at 5:10 AM
Reply-To: EnergyPlus_Support@yahoogroups.com
To: EnergyPlus_Support@yahoogroups.com

Jim,

Slightly sidetracking from Jenny's question but... ASHRAE 90.1-2004 User's Manual says that 22 W/gpm corresponds to a 75 ft head with a 60% motor and impeller efficiency. Using the same equation as you (which I'm usually using), I get a 70.1 ft head.

The User's Manual also says that 19 W/gpm translated to a 60 ft head with a 60% combined efficiency.

75/22 = 3.41
60/19 = 3.16

Their relationship between head and power/flow (at constant efficiency) does not seem to be linear. Any idea how they calculated that?

Thanks,
Patrick

[Quoted text hidden]
> Therefore, if desired W / GPM = 'x' (and ç = 0.78 x 1.00)
>
> - Chilled water; ASHRAE 90.1 baseline
>
> DeltaP =
>
> 22
>
> =
>

> 91.1
>
> ft. H2O
>
>
> 0.2414
>
>
> =
>
> 272,420
>
> Pa (Use this for ASHRAE 90.1 Baseline)
>
>
> Similarly, for Heating and condenser pumps
>
> DeltaP =
>
> 19
>
> =
>
> 78.7
>
> ft. H2O
>
>
> 0.2414
>
>
> =
>
> 235,270
>
> Pa (Use this for ASHRAE 90.1 Baseline)
>
>
> Note:
>
> E+ assumes a pump mechanical efficiency of 0.78. For this derivation to remain correct, use a motor efficiency of 1.00
>
>

>
>
> James V Dirkes II, PE, BEMP, LEED AP
> www.buildingperformanceteam.com<http://www.buildingperformanceteam.com/>
> Energy Analysis, Commissioning & Training Services
> 1631 Acacia Drive, Grand Rapids, MI 49504 USA
> 616 450 8653
>
> From: EnergyPlus_Support@yahoogroups.com [mailto:EnergyPlus_Support@yahoogroups.com] On Behalf Of Jenny Zhang
> Sent: Saturday, May 04, 2013 5:46 AM
> To: 'EnergyPlus_Support@yahoogroups.com'
> Subject: [EnergyPlus_Support] Question about how to set 90.1 baseline pump in Energyplus
>
>
> Hi All friends
> I have questions about how to set 90.1 baseline pumps in E+
>
>
> 1) The condense water pumps
>
> 90.1 G3.1.3.11 states that Each chiller shall be modeled with separate condenser water and chilled-water pumps interlocked to operate with the associated chiller.
>
> For chilled water pumps it is easy to solved, because we could set CHW pumps in each chiller chilled water branch and of course the chilled water pump will run only the chiller run; but for condenser water pumps I face the problem that I could put cw pumps in chiller condenser water-side branch.
>
> Does E+ requires condenser water pumps to be put only on the condenser water branch?
>
> I think there is two way to do the setting: (1) set headed pumps in the cw supply side branch or (2) set more than one cw tower(same as chiller nos) and for each cw tower put a condenser water pump in the branch.
>
> Which is better? Or Do you have other method?
>
>
>
> 2) Pump power
>
> 90.1requries pump power for chilled water/hot water/condenser water pumps. How to set it? In eQuest usually I use pump head & total efficiency to ensure the power/flow rate(such as 75ft&65% =22W/gpm),
>
> But in E+ I find it difficult to do the same setting. Only motor efficiency can be input, and how about pump efficiency? Is it 78%, I find in the EngineeringReference.pdf "The motor efficiency is an input. Since we need the total efficiency to calculate the nominal power consumption we assume an impeller efficiency of 0,78 for purposes of sizing". Does it means that the total efficiency is motor efficiency* 0.78 or we can use "Fraction of motor inefficiencies

to fluid stream" to control the total efficiency? I really confused.
>
>
> [cid:image001.png@...]
>
> Many thanks!
>
>
> Best Regards
>
> Jenny Zhang
> Assistant Engineer | Building Sustainability
>
> Arup
> 39/F-41/F Huaihai Plaza 1045 Huaihai Road (M), Shanghai 200031, China
> t +86 21 3118 8888 d +86 21 3118 8750
> f +86 21 3118 8882
> www.arup.com<http://www.arup.com/>
>
>
> _____
> Electronic mail messages entering and leaving Arup business
> systems are scanned for acceptability of content and viruses
>

__._,_.___

http://groups.yahoo.com/group/EnergyPlus_Support/

Attachments are currently allowed but be mindful that not everyone has a high speed connection. Limit attachments to small files.

EnergyPlus Documentation is searchable. Open EPlusMainMenu.pdf under the Documentation link and press the "search" button.

__,_._,___

Jim Dirkes <jim@buildingperformanceteam.com> Mon, May 6, 2013 at 3:30 AM
Reply-To: EnergyPlus_Support@yahoogroups.com
To: "EnergyPlus_Support@yahoogroups.com" <EnergyPlus_Support@yahoogroups.com>

Patrick,

I'm not sure I completely understand your question, but….

- ASHRAE's math works properly to produce either 22 or 19W / gpm
- ASHRAE seems to think that it is common to have combined motor + impeller efficiency of 60%, and I think that is reasonable as well
- The selection of 75 feet or 60 feet of head for those different systems is a judgment call, I think
  - You can certainly argue that condenser water systems are generally shorter and have less overall head
  - Similarly chilled water systems are longer, have more coil rows, etc.
  - Hot water systems are normally of similar length to chilled water, but have less coil rows and heat exchanger tubes
- So, overall, I think ASHRAE's goal was to reflect a typical "pretty good" pumping system design for the Baseline pump power limitations.

Does that help?

James V Dirkes II, PE, BEMP, LEED AP
www.buildingperformanceteam.com
Energy Analysis, Commissioning & Training Services
1631 Acacia Drive, Grand Rapids, MI 49504 USA
616 450 8653

From: EnergyPlus_Support@yahoogroups.com [mailto:EnergyPlus_Support@yahoogroups.com] **On Behalf Of** patrick_bivona
Sent: Saturday, May 04, 2013 11:11 PM
To: EnergyPlus_Support@yahoogroups.com
Subject: [EnergyPlus_Support] Re: Question about how to set 90.1 baseline pump in Energyplus

[Quoted text hidden]

—.–,–.—

—,–.–,—

Jenny Zhang <jenny.zhang@arup.com> Mon, May 6, 2013 at 7:51 AM
Reply-To: EnergyPlus_Support@yahoogroups.com
To: "EnergyPlus_Support@yahoogroups.com" <EnergyPlus_Support@yahoogroups.com>

All,

Thanks for all your kindly reply.

James, I used your method to set the pumps. I used 18m/23m head with 60%&65% total pump efficiency and got the results below.

It is still not match 349kW/1000L/s and 301kW/1000L/s.

Is the “Power” (in the red) the motor input power? Or the pump mechanical efficiency is not 0.78?

Have you checked baseline pump power in your model before? I am not very confident about my setting.

Thanks!

	Type	Control	Head [pa]	Water Flow [m3/s]	Electric Power [W]	Power Per Water Flow Rate [W-s/m3]	Motor Efficiency [W/W]
CHW LOOP CHW SECONDARY PUMP	HeaderedPumps:VariableSpeed	Intermittent	150400.00	0.3913	90567.40	231477.21	0.83
HW LOOP HW SUPPLY PUMP	Pump:VariableSpeed	Intermittent	176515.00	0.1824	53594.26	293897.77	0.77
CHILLER1 CHW BRANCH PUMP	Pump:ConstantSpeed	Intermittent	75000.00	0.0810	9349.89	115430.79	0.83
CHILLER2 CHW BRANCH PUMP	Pump:ConstantSpeed	Intermittent	75000.00	0.0810	9349.89	115430.79	0.83
CHILLER3 CHW BRANCH PUMP	Pump:ConstantSpeed	Intermittent	75000.00	0.0810	9349.89	115430.79	0.83
CHILLER4 CHW BRANCH PUMP	Pump:ConstantSpeed	Intermittent	75000.00	0.0810	9349.89	115430.79	0.83
CHILLER5 CHW BRANCH PUMP	Pump:ConstantSpeed	Intermittent	75000.00	0.0810	9349.89	115430.79	0.83
CW TOWER1 CNDW BRANCH PUMP	Pump:ConstantSpeed	Intermittent	176515.00	0.1090	32034.86	293897.77	0.77

CW TOWER2 CNDW BRANCH PUMP	Pump:ConstantSpeed	Intermittent	176515.00	0.1090	32034.86	293897.77	0.77
CW TOWER3 CNDW BRANCH PUMP	Pump:ConstantSpeed	Intermittent	176515.00	0.1090	32034.86	293897.77	0.77
CW TOWER4 CNDW BRANCH PUMP	Pump:ConstantSpeed	Intermittent	176515.00	0.1090	32034.86	293897.77	0.77
CW TOWER5 CNDW BRANCH PUMP	Pump:ConstantSpeed	Intermittent	176515.00	0.1090	32034.86	293897.77	0.77

From: EnergyPlus_Support@yahoogroups.com [mailto:EnergyPlus_Support@yahoogroups.com] **On Behalf Of** Jim Dirkes
Sent: 2013年5月6日 9:30
To: EnergyPlus_Support@yahoogroups.com
Subject: RE: [EnergyPlus_Support] Re: Question about how to set 90.1 baseline pump in Energyplus

[Quoted text hidden]

—·–’–·——

The group web site is:
http://groups.yahoo.com/group/EnergyPlus_Support/

Attachments are currently allowed but be mindful that not everyone has a high speed connection. Limit attachments to small files.

EnergyPlus Documentation is searchable. Open EPlusMainMenu.pdf under the Documentation link and press the "search" button.

__,_._,___

Jim Dirkes <jim@buildingperformanceteam.com> Mon, May 6, 2013 at 1:18 PM
Reply-To: EnergyPlus_Support@yahoogroups.com
To: "EnergyPlus_Support@yahoogroups.com" <EnergyPlus_Support@yahoogroups.com>

Jenny,

Take a look at the this part of the attached file…. and experiment with different values for pressure rise and efficiency.

When SI units are known:					
m3/s	Pa	Pump Eff'y	Motor Eff'y	Power	kW / m3/s
0.3913	150,400	0.78	0.83	90,904	232
GPM	ft H2O	Pump Eff'y	Motor Eff'y	Power	W/GPM
6,203	50.3	0.78	0.83	90,773	14.6

James V Dirkes II, PE, BEMP, LEED AP
www.buildingperformanceteam.com
Energy Analysis, Commissioning & Training Services
1631 Acacia Drive, Grand Rapids, MI 49504 USA
616 450 8653

From: EnergyPlus_Support@yahoogroups.com [mailto:EnergyPlus_Support@yahoogroups.com] **On Behalf Of** Jenny Zhang
Sent: Monday, May 06, 2013 1:51 AM

[Quoted text hidden]

[Quoted text hidden]

Pump power.xlsb
12K

---

patrick_bivona <patrick.bivona@gmail.com> Mon, May 6, 2013 at 2:23 PM
Reply-To: EnergyPlus_Support@yahoogroups.com
To: EnergyPlus_Support@yahoogroups.com

Jim,

Thanks for your answer. Sorry my question was confusing. I wasn't questioning ASHRAE's choice of pump power. Rather, I was trying to understand what math ASHRAE is using to get a 75 ft head from a 22 W/gpm pump at 60% efficiency. Your math (and mine) gives a 70.1 ft head, unless I'm mistaken. They're probably using something more sophisticated than Power = Flow rate * Head pressure / Efficiency

I'm just being curious, that's all!

Patrick

--- In EnergyPlus_Support@yahoogroups.com, Jim Dirkes <jim@...> wrote:
>
> Patrick,
> I'm not sure I completely understand your question, but....
>

> · ASHRAE's math works properly to produce either 22 or 19W / gpm
>
> · ASHRAE seems to think that it is common to have combined motor + impeller efficiency of 60%, and I think that is reasonable as well
>
> · The selection of 75 feet or 60 feet of head for those different systems is a judgment call, I think
>
> o You can certainly argue that condenser water systems are generally shorter and have less overall head
>
> o Similarly chilled water systems are longer, have more coil rows, etc.
>
> o Hot water systems are normally of similar length to chilled water, but have less coil rows and heat exchanger tubes
>
> · So, overall, I think ASHRAE's goal was to reflect a typical "pretty good" pumping system design for the Baseline pump power limitations.
> Does that help?
>
>
> James V Dirkes II, PE, BEMP, LEED AP
> www.buildingperformanceteam.com<http://www.buildingperformanceteam.com/>
> Energy Analysis, Commissioning & Training Services
> 1631 Acacia Drive, Grand Rapids, MI 49504 USA
> 616 450 8653
>
> From: EnergyPlus_Support@yahoogroups.com [mailto:EnergyPlus_Support@yahoogroups.com] On Behalf Of patrick_bivona
> Sent: Saturday, May 04, 2013 11:11 PM
> To: EnergyPlus_Support@yahoogroups.com
> Subject: [EnergyPlus_Support] Re: Question about how to set 90.1 baseline pump in Energyplus
>
>
>
> Jim,
>
> Slightly sidetracking from Jenny's question but... ASHRAE 90.1-2004 User's Manual says that 22 W/gpm corresponds to a 75 ft head with a 60% motor and impeller efficiency. Using the same equation as you (which I'm usually using), I get a 70.1 ft head.
>
> The User's Manual also says that 19 W/gpm translated to a 60 ft head with a 60% combined efficiency.
>
> 75/22 = 3.41
> 60/19 = 3.16
>
> Their relationship between head and power/flow (at constant efficiency) does not seem to be linear. Any idea how they calculated that?
>
> Thanks,
> Patrick

>

[Quoted text hidden]
> > From: EnergyPlus_Support@yahoogroups.com<mailto:EnergyPlus_Support%40yahoogroups.com> [mailto:EnergyPlus_Support@yahoogroups.com<mailto:EnergyPlus_Support%40yahoogroups.com>] On Behalf Of Jenny Zhang
> > Sent: Saturday, May 04, 2013 5:46 AM
> > To: 'EnergyPlus_Support@yahoogroups.com<mailto:%26%2339%3BEnergyPlus_Support%40yahoogroups.com>'
> > Subject: [EnergyPlus_Support] Question about how to set 90.1 baseline pump in Energyplus
> >
> >
> > Hi All friends
> > I have questions about how to set 90.1 baseline pumps in E+
> >
> >
> > 1) The condense water pumps
> >
> > 90.1 G3.1.3.11 states that Each chiller shall be modeled with separate condenser water and chilled-water pumps interlocked to operate with the associated chiller.
> >
> > For chilled water pumps it is easy to solved, because we could set CHW pumps in each chiller chilled water branch and of course the chilled water pump will run only the chiller run; but for condenser water pumps I face the problem that I could put cw pumps in chiller condenser water-side branch.
> >
> > Does E+ requires condenser water pumps to be put only on the condenser water branch?
> >
> > I think there is two way to do the setting: (1) set headed pumps in the cw supply side branch or (2) set more than one cw tower(same as chiller nos) and for each cw tower put a condenser water pump in the branch.
> >
> > Which is better? Or Do you have other method?
> >
> >
> >
> > 2) Pump power
> >
> > 90.1requries pump power for chilled water/hot water/condenser water pumps. How to set it? In eQuest usually I use pump head & total efficiency to ensure the power/flow rate(such as 75ft&65% =22W/gpm),
> >
> > But in E+ I find it difficult to do the same setting. Only motor efficiency can be input, and how about pump efficiency? Is it 78%, I find in the EngineeringReference.pdf "The motor efficiency is an input. Since we need the total efficiency to calculate the nominal power consumption we assume an impeller efficiency of 0,78 for purposes of sizing". Does it means that the total efficiency is motor efficiency* 0.78 or we can use "Fraction of motor inefficiencies to fluid stream" to control the total efficiency? I really confused.
> >
> >
> > [cid:image001.png@]

> >
> > Many thanks!
> >
> >
> > Best Regards
> >
> > Jenny Zhang
> > Assistant Engineer | Building Sustainability
> >
> > Arup
> > 39/F-41/F Huaihai Plaza 1045 Huaihai Road (M), Shanghai 200031, China
> > t +86 21 3118 8888 d +86 21 3118 8750
> > f +86 21 3118 8882
> > www.arup.com<http://www.arup.com/>
> >
> >
> > _____
> > Electronic mail messages entering and leaving Arup business
> > systems are scanned for acceptability of content and viruses
> >
>

__.-._.-.___

Primary EnergyPlus support is found at:
http://energyplus.helpserve.com or send a message to energyplus-support@gard.com

The primary EnergyPlus web site is found at:
http://www.energyplus.gov

The group web site is:
http://groups.yahoo.com/group/EnergyPlus_Support/

Attachments are currently allowed but be mindful that not everyone has a high speed connection. Limit attachments to small files.

EnergyPlus Documentation is searchable. Open EPlusMainMenu.pdf under the Documentation link and press the "search" button.

—,—.—,—

Jim Dirkes <jim@buildingperformanceteam.com> Mon, May 6, 2013 at 4:33 PM
Reply-To: EnergyPlus_Support@yahoogroups.com
To: "EnergyPlus_Support@yahoogroups.com" <EnergyPlus_Support@yahoogroups.com>

Patrick,

Take a look at the small spreadsheet file I attached to my response to Jenny earlier today. I think that will help. If not and you are in the USA, give me a call.

From: EnergyPlus_Support@yahoogroups.com [mailto:EnergyPlus_Support@yahoogroups.com] **On Behalf Of** patrick_bivona
Sent: Monday, May 06, 2013 8:23 AM

[Quoted text hidden]

[Quoted text hidden]

—.—,—.—

Primary EnergyPlus support is found at:
http://energyplus.helpserve.com or send a message to energyplus-support@gard.com

The primary EnergyPlus web site is found at:
http://www.energyplus.gov

The group web site is:
http://groups.yahoo.com/group/EnergyPlus_Support/

Attachments are currently allowed but be mindful that not everyone has a high speed connection. Limit attachments to small files.

EnergyPlus Documentation is searchable. Open EPlusMainMenu.pdf under the Documentation link and press the "search" button.

__,_._,___