REPORT OF THE SCBPS
HOT WATER DELIVERY IN BUILDINGS

Presented by Ken Newbert, P. Eng, Chair - SCBPS

Background:

Since 2001 the Canadian Medical Association has been urging provincial and territorial governments to amend codes to require delivery of hot water at 49^{o} Celsius to address the safety of children and the elderly who are being scalded in significant numbers.

The growth of legionella bacteria in hot water systems was also a concern. There is strong evidence that the incidence of legionella disease due to domestic hot water is significant and very likely higher than the incidence rates of scalding by tap water.

The Canadian Commission on Building and Fire Codes (CCBFC) suggested that the Standing Committee on Building and Plumbing Services (SCBPS) form a Task Group (TG) to examine this issue.

The Standing Committee on Building and Plumbing Services formed a TG, with broad stakeholder representation. This TG searched and reviewed considerable information in 3 meetings held on January 24-25, March 7-8 and April 14-15, 2005. Information was provided to TG members by a number of manufacturers of hot water heating system components, hydro and gas utilities, the medical community including physicians, consultants and nurses.

The TG examined health and safety risks associated with hot water delivery in buildings and made recommendations to the SCBPS at its 12th meeting on June 27-28, 2005. This report of the TG was accepted by the SCBPS. In brief the recommendations are:

- The temperature of water supplied to a shower, a bathtub or a lavatory shall not exceed 49ºC in all buildings
- Service water heaters shall be set to provide a water storage temperature of not less than 60^{o}C in all buildings

The SCBPS agreed that these changes be issued as **Interim changes** to the NPC 2005.

The proposals for change and appendix information as finalized by staff for the SCBPS are in **Appendix A**. The report of the TG and the detailed terms of reference for the TG and membership are in **Appendix B**.

The SCBPS review of the TG report led to revisions to the proposed wording for the code changes and the appendix information.

DISCUSSION

In arriving at these recommendations for hot water delivery in buildings, observations were made by members of the SCBPS.

1. Scalding and Legionella

- It was agreed that scalding and legionella are issues that need to be addressed. It was concluded that there is strong evidence that the incidence of legionella disease due to domestic hot water is significant and very likely higher than the incidence rates of scalding by tap water. Scalding is something that can be addressed by measures to prevent it, whereas legionella disease can be found in persons that have no underlying medical history. There is no available practical means to identify legionella bacteria proliferation in domestic hot water systems.
- An Appendix Note providing background information for code users is necessary to explain that addressing scalding and legionella is a delicate balancing act. The committee felt that since the solutions are contradictory, it would be appropriate to explain and elaborate on the concerns in a comprehensive note. The appendix provides guidance and advice. It does not provide information on how to comply. This is intentional. The committee felt that if a solution is described in the appendix, it tends to become the approved method of acceptance and the committee wanted to stay away from such examples.

2. Scalding – Hot Water Delivery

- Although the recommendation is to deliver water at 49ºC to showers and bathtubs, there is no mention of a specific method or prescription in the recommended wording. The committee was intentionally not specific. Expressing this in terms of an objectives-based requirement will permit development of solutions in the future that may come along due to changes in technology. This has happened in other cases where a code change has spurred the development of new solutions and with a drop in price of the products being used. It is felt that the price of thermostatic mixing valves will follow this scenario.
- The committee was assured by members who participate on the CSA B125, "Plumbing Fittings" committee that the 2001 edition of the standard, referenced in the NPC 2005, adequately covers the mixing valves that are most likely to be used for controlling the temperature of delivered hot water.

3. Scalding – Showers and Bathtubs

- Consensus was that showers and shower/tub combos should be addressed to protect from scalding and thermal shock and bathtubs should be addressed for scalding only. Thermal shock is an issue for showers only where a sudden change in temperature of the delivered water could result in a sudden evasive action that could result in a fall or slip. The SC believes that this change would result in 50% reduction in the incidence of scalding.

4. Scalding – Lavatories

- The inclusion of lavatories in the proposal results in a negative benefit to society, namely that there is $1 benefit for every $20 expended. Some members insisted that lavatories should be included, with the understanding that this was not economically justifiable. Lavatories in this context are sinks typically used for washing hands. The committee justified the inclusion of lavatories by stating that people need a safe place in their homes to wash their hands. It is the opinion of the SC that in time the fixture industry will respond with new technology such as

a temperature-limiting device in the valve or faucet and this may not add cost or if it does it would be minimal.

5. Legionella – Hot Water Storage

- With respect to legionella disease, there is no impact (cost or benefit) resulting from the proposed changes as hot water tanks are currently set at a temperature that controls the proliferation of legionella. Essentially it is recommended that the status-quo be maintained.

6. Access - Mixing Valves

- A concern was expressed at another meeting of having the mixing valve accessible, and this is covered by the NPC 1995 in Article 1.7.2. This Article is a blanket requirement and states that access to all devices for use, cleaning and maintenance has to be provided.

7. Energy Conservation

- A concern was raised that requiring the tanks to be set at 60°C to avoid the growth of legionella bacteria goes against the trend for energy conservation. It was noted that although "energy conservation" is not an objective of the NPC, there are mitigating factors valid for Canada. In our climate where we practically need to heat our homes for close to 9 months in a year, the heat loss from the water heater will be a useful heat gain to the house or building.

8. Retrofit

- The committee endorsed the issue of "retrofit" with the following statement.

Retrofit Situations:
Philosophically, this Committee is supportive of applying the proposed code amendments in retrofit situations. At the same time, it is recognized that this cannot be covered in the Code the way it is administered. In order to deal with this, the authority having jurisdiction must determine how they are going to deal with and enforce these requirements if they feel this is necessary.

However, the committee has reservations regarding the practicality of applying the proposed revisions to existing stock. Although a cost benefit analysis was not done on retrofit, preliminary numbers indicate that the cost/benefit ratio is higher than that for new construction.

The proposed changes for these recommendations listed below are in Appendix A.

1. - 2.2.10.7. Shower Valves,
2. - 2.6.1.1. Design, Fabrication and Installation,
3. - 2.6.1.12. Service Water Heaters,
4. - A - 2.2.10.7. Maximum Hot Water Temperature**,** and
   A - 2.6.1.12.(1) Service Water Heaters, and
5. - 9.31.6.1. Hot Water Supply.

Appendix A.

Proposed Changes dealing with Hot water Delivery in Buildings

1. - 2.2.10.7. Shower Valves,
2. - 2.6.1.1. Design, Fabrication and Installation,
3. - 2.6.1.12. Service Water Heaters,
4. - A - 2.2.10.7. Maximum Hot Water Temperature**,** and
   A - 2.6.1.12.(1) Service Water Heaters, and
5. - 9.31.6.1. Hot Water Supply.

Document	NBC 2005 TEMP CNB	Document
Provision	2.2.10.7.	Exigence
Committee	BPS •	Comité
Minutes	BPS 12 Agenda Pg.27	Procès-verbaux

EXISTING PROVISION

2.2.10.7. Shower Valves

1) Except as provided for in Sentences (2) and (3), all valves supplying fixed location shower heads shall be individual pressure-balanced or thermostatic-mixing valves conforming to CSA B125, "Plumbing Fittings."

2) Individual pressure-balanced or thermostatic-mixing valves shall not be required for showers if a single tempered water supply for such showers is controlled by a master thermostatic-mixing valve conforming to CSA B125, "Plumbing Fittings."

3) Deck-mounted hand-held flexible hose-connected spray attachments are exempt from the requirements of Sentence (1).

4) Pressure-balanced and thermostatic- mixing valves shall be

a) designed such that the outlet temperature does not exceed 49°C, or

b) equipped with high-limit stops which shall be adjusted to a maximum hot water setting of 49°C.

PROPOSED CHANGE

Replace Article 2.2.10.7.

2.2.10.7. Water Temperature Control

1) All valves supplying showerheads shall be pressure-balanced, thermostatic, or combination pressure-balanced thermostatic mixing valves capable of:

(a) maintaining a water outlet temperature that does not exceed 49ºC and

(b) limiting thermal shock.

2) The temperature of water discharging into a bathtub or lavatory shall not exceed 49ºC.

(See Appendix A)

RATIONALE

Problem

Hot water delivered to fixtures at too high a temperature will result in scald burn injuries. At the same time, hot water stored at too low a temperature will lead to the proliferation of legionella bacteria.

Justification - Explanation

The requirements of Article 2.2.10.7. address concerns that were discussed in detail by a task group representing various stakeholders in consultations in 3 meetings. Domestic hot water is responsible for the highest number of fatal and severe scalding injuries among children and the elderly in Canada. Groups at special risk for scald burn injury include children, seniors, people with disabilities, diabetes and other health conditions that relate to reduced skin sensitivity.

- Most of the severe tap water scald injuries take place in the bathroom in the bath and they tend to be extensive body scalds due to full immersion
- Hospital admission statistics support this and indicate the breakdown is 67% baths, 6% showers, 9% in lavatories, 9% kitchen sinks and the remainder elsewhere.

These cases could be prevented or reduced if the water supply temperature was controlled.
Sentences (1) and (2) deal with the issue of supplying hot water at a temperature not higher than 49ºC to deal with the concern of scalding. Sentence (1) also addresses thermal shock from either individual or multiple showerheads.

There is also evidence that lowering the thermostat in the hot water tank increases the presence of legionella because the environment becomes favourable for the bacteria to multiply. This is addressed in proposed changes to Sentences 2.6.1.1.(4) and (5) and Article 2.6.1.12.

Cost implications

Possible solutions include temperature control devices at each regulated fixture, or located in a strategic location(s).

For a typical dwelling unit, the cost may run from $135 per point-of-use mixing valve supplying up to 10 USgpm, to $200 for a master-mixing valve, to $500 for a centralized system (master-mixing valve and separate piping for dishwasher and clothes washer).

The Code already requires temperature and thermal shock control for showers and shower/tub combinations. The additional costs for this proposed Code change relate to lavatories and stand-alone bathtubs. The major portion of this cost is due to the inclusion of lavatories.

Lavatories have been included for safety reasons. It is acknowledged by the committee that the inclusion of lavatories is not justified on the basis of cost benefit. The main reason for inclusion of lavatories was to provide people with a safe place to wash their hands in their homes.

If the problem is addressed for bathtubs and showers. This would result in 50% reduction in incidences of scalding. Including the lavatories would result in a further reduction of 9% of scald injuries.

For new construction, the total annual societal problem cost of scalding to Canada is estimated to be $8.4M to $50M (based on 168 and 1000 incidents respectively). The total annual societal solution benefit to Canada is estimated to be $0.7M to $4.2M. The major portion of these benefits relates to addressing stand-alone bathtubs. This is based on $0.1M per patient per year over the lifetime of that patient. The estimated annual cost to achieve this range of benefits is $48M to $119M (Page 36 of Agenda package of meeting #2, Page 4 of Second minutes). This estimated cost does not include out-patient care, which could increase the total annual societal solution benefit.

With respect to legionella disease, there is no impact (cost or benefit) since the status-quo is basically being maintained.

Enforcement implications

The wording of this requirement will impact on the workload of the code authorities to ensure compliance with the code requirements. They may have to measure the water temperature at the fixture outlet to ensure compliance.

OBJECTIVE-BASED ANALYSIS OF CHANGED OR NEW PROVISION

Provision: 2.2.10.7.(1)(a) **Analysis:**

Code Extract Analyzed

1) All valves supplying showerheads shall be pressure-balanced, thermostatic, or combination pressure-balanced thermostatic mixing valves capable of:

(a) maintaining a water outlet temperature that does not exceed 49°C and

Type of Provision

Requirement

Functional Statement(s)

F31- To minimize the risk of injury to persons as a result of contact with hot surfaces or substances.

Objective

OS3.2 - Contact with hot surfaces or substances.

Application

Temperature of water in valves supplying showerheads in all buildings.

Intent(s)

I1. To limit the probability that lack of an appropriate measure, will lead to an inability to limit the temperature of hot water discharging from the showerhead, which could lead to exposure to excessively high water temperatures in showers. This to limit the probability of harm to persons.

Provision: 2.2.10.7.(1)(b) **Analysis:**

Code Extract Analyzed

1) All valves supplying showerheads shall be pressure-balanced, thermostatic, or combination pressure-balanced thermostatic mixing valves capable of:

(b) limiting thermal shock.

Type of Provision

Requirement

Functional Statement(s)

F30 – To minimize risk of injury to persons as a result of tripping, slipping, falling, contact drowning or collision

Objective

OS3.1 - Tripping, slipping, falling, contact drowning or collision

Application

Temperature of water in valves supplying showerheads in all buildings.

Intent(s)

I2. To limit the probability that lack of an appropriate measure, will lead to an inability to control the temperature of hot water discharging from the shower head, which could lead to unexpected variations in water temperature, due to the use of other fixtures, which could lead evasive action leading to trips or falls. This is to limit the probability of harm to persons.

OBJECTIVE-BASED ANALYSIS OF CHANGED OR NEW PROVISION

Provision: 2.2.10.7.(2) **Analysis:**

Code Extract Analyzed

2) The temperature of water discharging into a bathtub or lavatory shall not exceed 49ºC.

Type of Provision

Requirement

Functional Statement(s)

F31- To minimize the risk of injury to persons as a result of contact with hot surfaces or substances.

Objective

OS3.2 – Contact with hot surfaces or substances

Application

Temperature of water discharging into a bathtub or lavatory in all buildings.

Intent(s)

To limit the probability that lack of an appropriate measure, will lead to an inability to limit the temperature of hot water discharging into bathtubs or lavatories, which could lead to exposure to excessively high water temperatures. This is to limit the probability of harm to persons.

Document	NBC 2005 TEMP CNB	Document
Provision	2.6.1.1.(4) and (5)	Exigence
Committee	BPS •	Comité
Minutes	BPS 12 Agenda Pg.27	Procès-verbaux

EXISTING PROVISION

None

PROPOSED CHANGE

Add new Sentences 2.6.1.1.(4) and (5):

2.6.1.1. Design, Fabrication and Installation

4) For a hot water distribution system having a re-circulating loop, the temperature of the water in the re-circulating loop shall be not less than 55°C when circulating. (See A – 2.6.1.12.(1) in Appendix A.)

5) The re-circulating loop referred to in Sentence (4) is permitted to be operated intermittently.

RATIONALE

Problem

Hot water delivered to fixtures at too high a temperature will result in scald burn injuries. At the same time, hot water stored at too low a temperature will lead to the proliferation of legionella bacteria.

Justification - Explanation

Domestic hot water is responsible for the highest number of fatal and severe scalding injuries among children and the elderly in Canada. These cases could be prevented or reduced if the water supply temperature was controlled. Proposed revisions to Article 2.2.10.7. deal with the issue of supplying hot water at a temperature not higher than 49ºC to deal with the concern of scalding.

There is also evidence that lowering the water temperature in the hot water tank and distribution systems increases the presence of legionella because the environment becomes favourable for the bacteria to multiply. Available information indicates that the incidence of legionella disease due to domestic hot water is significant and very likely higher than previously thought. Legionella disease can be found in persons having no underlying medical history, but is more likely to affect immuno-suppressed individuals, smokers, individuals with chronic diseases and the elderly. It is very difficult to identify sporadic cases of legionella caused by conditions in domestic hot water systems in relation to other sources of exposure. It is particularly difficult to diagnose legionella disease and is commonly misdiagnosed as atypical pneumonia.

Sentence 2.6.1.1.(4) ensures that in re-circulating loop systems, the circulating water in the loop is maintained at a temperature of 55°C to reduce the probability of growth of bacteria in the piping system. A clarification is being provided in Sentence (5) to allow the re-circulating system to run intermittently if required or if so designed.

New Article 2.6.1.12. is also being included to address the concern of legionella bacteria in hot water storage tanks and will enable enforcement without introducing unnecessary complications. Contemporary electric water heater tanks experience temperature stratification and thus tend to have legionella bacteria in lower parts of the tank. Specifying a minimum storage temperature of 60°C addresses this concern for all types of water heaters without being specific for the different designs and fuel sources.

Maintaining the water heater tank temperature at not less than 60°C will prevent situations where the water temperature cool-off will not be significant. This would avoid situations where the building would run out of hot water in typical use. However, this also raises the necessity that some form of hot water temperature control has to be available for all regulated fixtures.

Cost implications

With respect to legionella disease, there is no impact (cost or benefit) since the status-quo is basically being

maintained.

Enforcement implications

The wording of this requirement will not impact on the workload of the code authorities to ensure compliance with the code requirements.

OBJECTIVE-BASED ANALYSIS OF CHANGED OR NEW PROVISION

Provision: 2.6.1.1.(4) **Analysis:**

Code Extract Analyzed

4) For a hot water distribution system having a re-circulating loop, the temperature of the water in the re-circulating loop shall be not less than 55°C when circulating.

Type of Provision

Requirement

Functional Statement(s)

F40- To limit the level of contaminants.

Objective

OH1.1– Inadequate indoor air quality

Application

Temperature of hot water in distribution system having a re-circulating loop when circulating.

Exception

Not applicable.

Intent(s)

To limit the probability of insufficient water temperature in the re-circulation loop, which could lead to the growth of legionella bacteria, which could lead to harm to persons.

OBJECTIVE-BASED ANALYSIS OF CHANGED OR NEW PROVISION

Provision: 2.6.1.1.(5) **Analysis:**

Code Extract Analyzed

5) The re-circulating loop referred to in Sentence (4) is permitted to be operated intermittently.

Type of Provision

Clarification.

Functional Statement(s)

Not applicable.

Objective

Not applicable.

Application

Intermittent operation of hot water distribution system having a re-circulating loop.

Intent(s)

To clarify that water in a re-circulating loop referred to in Sentence (4) does not have to be circulated continuously.

Comments

This implies that water temperature is permitted to be less than 55°C when water is not circulating.

Document	NBC 2005 TEMP CNB	Document
Provision	2.6.1.12. Service Water Heaters	Exigence
Committee	BPS •	Comité
Minutes	BPS 12 Agenda Pg.27	Procès-verbaux

EXISTING PROVISION

None

PROPOSED CHANGE

Add new Article 2.6.1.12.

2.6.1.12. Service Water Heaters

1) Controls for storage type *service water heaters* shall be set to provide a water storage temperature of not less than 60°C. (See Appendix A.)

RATIONALE

Problem

Hot water delivered to fixtures at too high a temperature will result in scald burn injuries. At the same time, hot water stored at too low a temperature will lead to the proliferation of legionella bacteria.

Justification - Explanation

Domestic hot water is responsible for the highest number of fatal and severe scalding injuries among children and the elderly in Canada. These cases could be prevented or reduced if the water supply temperature was controlled. Proposed revisions to Article 2.2.10.7. deal with the issue of supplying hot water at a temperature not higher than 49ºC to deal with the concern of scalding.

There is also evidence that lowering the water temperature in the hot water tank and distribution systems increases the presence of legionella because the environment becomes favourable for the bacteria to multiply. Available information indicates that the incidence of legionella disease due to domestic hot water is significant and very likely higher than previously thought. Legionella disease can be found in persons having no underlying medical history, but is more likely to affect immuno-suppressed individuals, smokers, individuals with chronic diseases and the elderly. It is very difficult to identify sporadic cases of legionella caused by conditions in domestic hot water systems in relation to other sources of exposure. It is particularly difficult to diagnose legionella disease and is commonly misdiagnosed as atypical pneumonia.

This Article 2.6.1.12. is being included to address the concern of legionella bacteria in hot water storage tanks and will enable enforcement without introducing unnecessary complications. Contemporary electric water heater tanks experience temperature stratification and thus tend to have legionella bacteria in lower parts of the tank. Specifying a minimum storage temperature of 60°C addresses this concern for all types of water heaters without being specific for the different designs and fuel sources.

Maintaining the water heater tank temperature will prevent situations where the water temperature cool-off will not be significant. This would avoid situations where the building would run out of hot water in typical use. However, this also raises the necessity that some form of hot water temperature control has to be available for all regulated fixtures.

Cost implications

It ensures that with respect to legionella, there is no change in the situation as it exists currently. With respect to legionella disease, there is no impact (cost or benefit) since the status-quo is basically being maintained.

Enforcement implications

The wording of this requirement will not impact on the workload of the code authorities to ensure compliance with the code requirements the tanks will be shipped from the factories at these settings. Applicable standards will be modified to ensure this.

OBJECTIVE-BASED ANALYSIS OF CHANGED OR NEW PROVISION

Provision: 2.6.1.12.(1) **Analysis:**

Code Extract Analyzed

1) Controls for storage type *service water heaters* shall be set to provide a water storage temperature of not less than 60°C.

Type of Provision

Requirement.

Functional Statement(s)

F40- To limit the level of contaminants.

Objective

OH1.1 – Inadequate indoor air quality

Application

Controls for hot water temperature in storage type *service water heaters* in all *buildings*.

Intent(s)

To limit the probability that lack of insufficient hot water storage temperature, will lead to the proliferation of legionella bacteria, which could lead to harm to persons.

Comments

Document	NBC 2005 TEMP CNB	Document
Provision	A-2.2.10.7., A-2.6.1.12.(1)	Exigence
Committee	BPS •	Comité
Minutes	BPS 12 Agenda Pg.27	Procès-verbaux

EXISTING PROVISION

None.

PROPOSED CHANGE

Add Appendix notes:

Appendix Notes for Various requirements in the NPC 2005

A-2.2.10.7. Maximum Hot Water Temperature

Hot water delivered at 60°C will severely burn human skin in 1 to 5 seconds. At 49°C, the time for a full thickness scald burn to occur is 10 minutes. Children, elderly persons and persons with disabilities are most at risk.

To prevent scalding and thermal shock in a shower, Sentence (1) requires that it be installed with a pressure balanced, thermostatic, or combination pressure-balanced thermostatic-mixing valve with a maximum water outlet temperature of 49°C. Sentence 2.10.6.(1) of the NPC 95 requires that such valves conform to the CSA B125 Standard.

Protection must also be provided in a bathtub and lavatory, as required by Sentence (2). Any device used to provide such protection would also be required to conform to the CSA B125 Standard, as required by Sentence 2.2.10.6.(1).

These requirements apply to all occupancies. They are not limited to residential occupancies.

The water outlet temperature at other fixtures, such as a sink, laundry tray or bidet, is not addressed by Article 2.2.10.7. There may still be a scald risk at these fixtures.

A-2.6.1.12.(1) Service Water Heaters

Sentence (1) addresses legionella. Storing water at temperatures below 60°C in the hot water tank or in the delivery system will lead to the survival or growth of legionella bacteria. This concern should be addressed in designing hot water delivery systems. If water is heated to 60°C or higher, bacteria contamination of the hot water delivery system is minimized. This may be achieved at different thermostat settings for different heater types.

RATIONALE

Problem

Hot water delivered to fixtures at too high a temperature will result in scald burn injuries. At the same time, hot water stored at too low a temperature will lead to the proliferation of legionella bacteria.

Justification - Explanation

Appendix information is being provided to guide Code users on the options that are available to meet the specified code requirements.

Cost implications

None.

Enforcement implications

The wording of this requirement will not impact on the workload of the code authorities to ensure compliance with the code requirements.

OBJECTIVE-BASED ANALYSIS OF CHANGED OR NEW PROVISION

Provision: Not required. **Analysis:**

Document	NBC 2005 TEMP CNB	Document
Provision	9.31.6.1.	Exigence
Committee	BPS •	Comité
Minutes	BPS 12 Agenda Pg.41	Procès-verbaux

EXISTING PROVISION

9.31.6.1. Hot Water Temperature

1) Where a hot water supply is required by Article 9.31.4.3., equipment shall be installed that is capable of heating to at least 45°C but not above 60°C an adequate supply of service hot water for every *dwelling unit*.

PROPOSED CHANGE

Replace Provision 9.31.6.1.

9.31.6.1. Hot Water Supply

1) Where hot water is required to be supplied as per Article 9.31.4.3., equipment shall
(a) provide an adequate supply of hot water, and
(b) be installed in conformance with Part 7.

RATIONALE

Problem

Hot water delivered to fixtures at too high a temperature will result in scald burn injuries. At the same time, hot water stored at too low a temperature will lead to the proliferation of legionella bacteria.

Justification - Explanation

It is necessary to make this amendment in Part 9 of the NBC, to refer code users to the NPC via Part 7 of the NBC.

The requirements of Article 2.2.10.7. in the NPC address concerns that were discussed in detail by a task group representing various stakeholders in consultations in 3 meetings. Domestic hot water is responsible for the highest number of fatal and severe scalding injuries among children and the elderly in Canada. Groups at special risk for scald burn injury include children, seniors, people with disabilities, diabetes and other health conditions that relate to reduced skin sensitivity.

- Most of the severe tap water scald injuries take place in the bathroom in the bath and they tend to be extensive body scalds due to full immersion
- Hospital admission statistics support this and indicate the breakdown is 67% baths, 6% showers, 9% in lavatories, 9% kitchen sinks and the remainder elsewhere.

These cases could be prevented or reduced if the water supply temperature was controlled.

There is also evidence that lowering the thermostat in the hot water tank increases the presence of legionella because the environment becomes favourable for the bacteria to multiply. Available information indicates that the incidence of legionella disease due to domestic hot water is significant and very likely higher than previously thought. Legionella disease can be found in persons having no underlying medical history, but is more likely to affect immuno-suppressed individuals, smokers, individuals with chronic diseases and the elderly. It is very difficult to identify sporadic cases of legionella caused by conditions in domestic hot water systems in relation to other sources of exposure. It is particularly difficult to diagnose legionella disease and is commonly misdiagnosed as atypical pneumonia.

Review of this information indicates that scalding and legionella disease are issues that need to be addressed in the recommendations for dealing with hot water delivery in buildings. The solution must ensure that the domestic hot water system has the ability to supply hot water without running out in typical use. This has been a major concern where measures to prevent scalding have been implemented. This is addressed in proposed changes to Sentences

2.6.1.1.(4) and (5) and Article 2.6.1.12.

Cost implications

Possible solutions include temperature control devices at each regulated fixture, or located in a strategic location(s).

For a typical dwelling unit, the cost may run from $135 per point-of-use mixing valve supplying up to 10 USgpm, to $200 for a master-mixing valve, to $500 for a centralized system (master-mixing valve and separate piping for dishwasher and clothes washer).

The NPC already requires temperature and thermal shock control for showers and shower/tub combinations. The additional costs for this proposed Code change relate to lavatories and stand-alone bathtubs. The major portion of this cost is due to the inclusion of lavatories.

Lavatories have been included for safety reasons. It is acknowledged by the committee that the inclusion of lavatories is not justified on the basis of cost benefit. The main reason for inclusion of lavatories was to provide people with a safe place to wash their hands in their homes.

If the problem is addressed for bathtubs and showers. This would result in 50% reduction in incidences of scalding. Including the lavatories would result in a further reduction of 9% of scald injuries.

For new construction, the total annual societal problem cost of scalding to Canada is estimated to be $8.4M to $50M (based on 168 and 1000 incidents respectively). The total annual societal solution benefit to Canada is estimated to be $0.7M to $4.2M. The major portion of these benefits relates to addressing stand-alone bathtubs. This is based on $0.1M per patient per year over the lifetime of that patient. The estimated annual cost to achieve this range of benefits is $48M to $119M (Page 36 of Agenda package of meeting #2, Page 4 of Second minutes). This estimated cost does not include out-patient care, which could increase the total annual societal solution benefit.

With respect to legionella disease, there is no impact (cost or benefit).

Enforcement implications

The wording of this requirement will impact on the workload of the code authorities to ensure compliance with the code requirements. They may have to measure the water temperature at the fixture outlet to ensure compliance.

Code Extract Analyzed

1) Where hot water is required to be supplied as per Article 9.31.4.3., equipment shall
(a) provide an adequate supply of hot water, and

Type of Provision

Requirement

Functional Statement(s)

F40 – To limit the level of contaminants.
F71 – To provide facilities for personal hygiene.

Objective

OH2.1 – Exposure to human or domestic waste
OH2.3 – Inadequate facilities for personal hygiene
OH2.4 - Contact with contaminated surfaces

Application

A1. Equipment supplying hot water for <dwelling units > as required in Article 9.31.4.3. in < buildings > to which Part 9 applies.

Intent(s)

I1. To limit the probability of inadequate hot water supply, which could lead to

A. inability to maintain personal hygiene which could lead to growth of harmful bacterial, or
B. inability to clean-up waste or otherwise remove contaminants from building surfaces or contents.

This could lead to harm to persons.

Provision: 9.31.6.1.(1)(b) **Analysis:**

Code Extract Analyzed

1) Where hot water is required to be supplied as per Article 9.31.4.3., equipment shall …..

(b) be installed in conformance with Part 7.

Type of Provision

Signpost

Functional Statement(s)

NA

Objective

NA

Application

A1. Equipment supplying hot water for <dwelling units > as required in Article 9.31.4.3. in < buildings > to which Part 9 applies.

Intent(s)

I1. To direct code users to requirements for hot water supply referenced in Part 7 of the NBC, which refers to the NPC.

Appendix B

REPORT OF THE TASK GROUP ON HOT WATER DELIVERY IN BUILDINGS

Presented By Chair Arnold Knapp, TG - HWD

Background:

Since 2001 the Canadian Medical Association has been urging provincial and territorial governments to amend codes to require delivery of hot water at 49^{o} Celsius to address the safety of children and the elderly who are being scalded in significant numbers.

The Commission supported this concern and proposed that a technical change to the National Plumbing Code be developed by the Standing Committee on Building and Plumbing Services (SCBPS) for public review.

In April 2002 the Executive Committee was informed by water heater manufacturers that they support reducing scalding, but warned that hot water heating and storage tank thermostats should not be used to limit the temperature at the outlet to 49^{o} Celsius, as this increases the risk of legionella contamination in electric water heating devices.

The Executive Committee felt that there was a need for a broader review and recommended that the technical change of the SCBPS follow the normal process of public review.

A revised technical change and Appendix Note for the National Plumbing Code was reviewed in the spring of 2003. Comments both positive and negative were considered at the September 2003 meeting of the SCBPS. The SCBPS revised the wording of the technical change and its Appendix Note in an effort to resolve technical concerns.

An unusually high number of negative ballots (approximately 25%) were returned from the Commission in April 2004 and so it was concluded that the negative ballots could not be resolved without further study.

An ad hoc technical group recommended proposed changes and an Appendix Note that were considered by the CCBFC Executive Committee in June 2004. The revised technical changes included a requirement that the hot water storage tank thermostat not be used as the temperature regulating device, and revisions to the Appendix Note highlighted the concerns with legionella in the storage tank if the temperature was not kept sufficiently high. The technical change was issued as a letter ballot for Commission approval.

The CCBFC Executive Committee in September 2004 felt that the negative and affirmative ballots with comments raised significant issues. The Executive Committee

concluded that new information on the risks of legionella in hot water storage tanks, the costs and enforcement difficulties of implementing the technical change, the reliability of the hot water heating and storage technology and the reliability of thermostatic mixing valves called into question the overall results of the letter ballot. The Executive Committee recommended that the results of the letter ballot be set aside, the proposed technical changes be withdrawn and that a task group led by the Standing Committee on Building and Plumbing Services be formed, with broad stakeholder representation, to find an effective technical solution.

A national task group (TG) led by the Standing Committee on Building and Plumbing Services was created with wide consultation with the stakeholders. This task group reviewed the available information in 3 meetings held on January 24-25, March 7-8 and April 14-15, 2005.

The detailed terms of reference for the TG and membership are in **Appendix A**.

OBJECTIVES:
To examine the health and safety risks associated with hot water delivery in buildings and make recommendations to the SCBPS.

TASKS:
The TG will:
a) analyze and assess health and safety risks associated with hot water delivery in buildings by examining the following concerns, including but not limited to:

- reviewing medical information, statistics and circumstances of injuries related to scalding
- reviewing medical information, statistics and circumstances of legionella contaminations
- determining demographics and occupancies that are most at risk.

b) review relevant requirements in standards, the NPC, the NBC, and in other countries

c) develop alternatives

d) examine technical alternatives to consider:

- health and safety issues
- technical feasibility and reliability
- cost implications
- enforcement implications
- retrofit situations.

e) make recommendations to the SCBPS, including but not limited to:

- drafting appropriate code changes
- examining implications on reference standards
- examining exceptions to be considered.

SUMMARY OF FINDINGS

At the First meeting, scalding statistics from various sources indicated that:

- Most of the scalding injuries take place in the bathroom in the bath and they tend to be extensive body scalds due to full immersion (80%)
- The breakdown of the statistics is 80% baths, 10% showers and 10% kitchen sinks.

Statistics presented from Quebec indicated that of the total scalds seen in emergency, 50% of the scalds took place in the bath or shower. These cases would be prevented or protected if the bath or shower water supply temperature was controlled.

A breakdown of hospitalization statistics:

Scald Statistics	**Per 1 Million Population**	
	Canada	**Quebec**
Total Incidents	100	-
Emergency Consultation	40	20
Hospitalization	10	5
Death	0.8	0.43

In Quebec, it was stated that there were 31 deaths due to scalding between 1990 and 1999 and the NPC 95 was in effect from 1998.

Based on this information it was agreed that "scalding" is a concern to be addressed. However, the TG had to determine what fixtures need to be addressed; is it bathtubs, sinks, lavatories etc. This was examined later.

Once it was agreed that "scalding" is a concern, the TG reviewed information and statistics on legionella shown below.

The recurring theme in this discussion was that lowering the thermostat in the hot water tank increases the presence of legionella bacteria because the environment is favourable for them to multiply.

Legionella Statistics Per 1 Million Population	
Requiring medical consultation	80
Requiring Hospitalization	16
Deaths	1.6

With the presentation of the statistics a comparison of scald statistics in relation to the legionella statistics as shown in the table below:

Statistics Per 1 Million Population			
	Scalding		Legionella from DHW Systems
	Quebec	Canada	
Requiring medical consultation	20	40	80
Requiring Hospitalization	5	10	16
Deaths	0.4	0.8	1.6

It was concluded that there is strong evidence that the incidence of legionella disease due to domestic hot water is significant and very likely higher than the incidence rates of scalding by tap water. Scalding is something that can be addressed by measures to prevent it, whereas legionella disease can be found in persons that have no underlying medical history. There is no available practical means to identify legionella bacteria proliferation in domestic hot water systems.

With this information the TG agreed that scalding and legionella disease are issues to be addressed in the recommendations for dealing with hot water delivery in buildings. At the same time the solution will have to ensure that the domestic hot water system does have the ability to supply adequate hot water without running out. This has been a concern where measures to prevent scalding have been implemented.

At the Second meeting cost information was reviewed based on the use of mixing valves in new housing and for replacement water heaters:

	Annual Costs	
	Minimum (168 incidents – hospitalization)	Maximum (1000 incidents)
A – Cost of Problem (@ $100,000/incident)	$16.8M	$100M
B – Benefit of Solution (100% temperature control for new and retrofit)	$1.4M	$8.3M
C – Cost of Solution	$221M ($95M new and $126M retrofit)	$221M + cost of permits

This analysis indicated that there is a negative benefit to society, namely that there is $1 benefit for every $20 expended.

The TG reached consensus that showers and shower/tub combos should be addressed to protect from scalding and thermal shock and bathtubs should be addressed for scalding only. This would result in 50% reduction in the incidence of scalding. Some members

did not support this conclusion, especially if a minimum temperature for storing water at 60ºC was prescribed for the hot water tank. They felt that lavatories and bidets should be included. The Chair agreed to include lavatories, with the understanding that this was not economically justifiable and this information would be highlighted to the SCBPS and CCBFC. Lavatories in this context are sinks typically used for washing hands.

One member stated that since the inclusion of lavatories and bidets is not supported by data, including them without proper cost benefit justification would make the whole recommendation suspect at the SCBPS and the CCBFC. The cost-benefit numbers result in diminishing returns. Out of 33 hospitalized, 22 were from baths, 3 in showers and 3 in lavatories. It would cost $10M to cover lavatories resulting in less than 10% fewer scalding cases.

With this background discussion, the TG developed a proposal and finalized it at the Third meeting:

RECOMMENDATIONS

In arriving at these recommendations various observations were made. One theme that came up was that there is a need to do a better job of educating the population at large. Parents of newborn babies could be alerted at pre-natal classes and in hospitals. Utilities should insert brochures with the mailing of utility bills to inform homeowners and occupants. All concerned parties are urged to take advantage of these opportunities.

An Appendix Note to provide background information for code users is needed. It would explain that addressing scalding and legionella is a delicate balancing act. Solutions are contradictory and so would be appropriate to explain and elaborate on the concerns in a comprehensive Appendix Note.

Proposal for Changes to National Plumbing Code (1995)

Article 2.10.7. for NPC 2005 Interim Change Recommendation

Article 2.10.7.:

1) All valves supplying showerheads shall be pressure-balanced, thermostatic, or combination pressure-balanced thermostatic mixing valves capable of:
   (a) maintaining a water outlet temperature that does not exceed 49ºC and
   (b) limiting thermal shock.
2) Water discharging into a bathtub or lavatory shall not exceed 49ºC.
3) Thermostats for storage type *service water heaters* shall be set at not less than:
   (a) 60ºC for electrically powered heaters, and
   (b) 55ºC for fossil fuel fired heaters.
4) For hot water systems having a re-circulating loop, the re-circulating system shall maintain the minimum tank temperature in the recirculation loop.

Problem:

Hot water delivered to fixtures at too high a temperature will result in scald burn injuries. At the same time, hot water stored at too low a temperature will lead to the proliferation of legionella bacteria.

Justification - Explanation:

The requirements of Article 2.10.7. address concerns that were discussed in detail by a task group representing various stakeholders in consultations in 3 meetings. Domestic hot water is responsible for the highest number of fatal and severe scalding injuries among children and the elderly in Canada. Groups at special risk for scald burn injury include children, seniors, people with disabilities, diabetes and other health conditions that relate to reduced skin sensitivity.

- Most of the severe tap water scald injuries take place in the bathroom in the bath and they tend to be extensive body scalds due to full immersion
- Hospital admission statistics support this and indicate the breakdown is 67% baths, 6% showers, 9% in lavatories, 9% kitchen sinks and the remainder elsewhere.

These cases could be prevented or reduced if the water supply temperature was controlled.

There is also evidence that lowering the thermostat in the hot water tank increases the presence of legionella because the environment becomes favourable for the bacteria to multiply. Available information indicates that the incidence of legionella disease due to domestic hot water is significant and very likely higher than previously thought. Legionella disease can be found in persons having no underlying medical history, but is more likely to affect immuno-suppressed individuals, smokers, individuals with chronic diseases and the elderly. It is very difficult to identify sporadic cases of legionella caused by conditions in domestic hot water systems in relation to other sources of exposure. It is particularly difficult to diagnose legionella disease and is commonly misdiagnosed as atypical pneumonia.

Review of this information indicates that scalding and legionella disease are issues that need to be addressed in the recommendations for dealing with hot water delivery in buildings. The solution must ensure that the domestic hot water system has the ability to supply hot water without running out in typical use. This has been a major concern where measures to prevent scalding have been implemented.

Rationale:

Sentences (1) and (2) deal with the issue of supplying hot water at a temperature not higher than 49ºC to deal with the concern of scalding. Sentence (1) also addresses thermal shock from either individual or multiple showerheads.

Sentence (3) is being included to address the concern of legionella bacteria and will enable enforcement without introducing unnecessary complications. Contemporary electric water heater tanks experience temperature stratification and

thus tend to have legionella bacteria in lower parts of the tank. Thermostats for gas water heaters have markings indicating temperature and so it is fairly easy to ensure compliance. Electric water heaters can be shipped with the required setting of the thermostat.
Sentence (4) ensures that in re-circulating loop systems, the loop is maintained at the water heater tank temperature to reduce the probability of growth of bacteria in the piping system.

Maintaining the water heater tank temperature as stated in Sentence (3) will prevent situations where the water temperature cool-off will not be significant. This would avoid situations where the building would run out of hot water in typical use. However, this also raises the necessity that some form of hot water temperature control has to be available for all regulated fixtures.

Cost Benefit Analysis and Cost Implications:
Possible solutions include temperature control devices at each regulated fixture, or located in a strategic location(s).

For a typical dwelling unit, the cost may run from $135 per point-of-use mixing valve supplying up to 10 USgpm, to $200 for a master-mixing valve, to $500 for a centralized system (master-mixing valve and separate piping for dishwasher and clothes washer).

The Code already requires temperature and thermal shock control for showers and shower/tub combinations. The additional costs for this proposed Code change relate to lavatories and stand-alone bathtubs. The major portion of this cost is due to the inclusion of lavatories.

The TG reached the conclusion that the problem should be addressed for bathtubs and showers. This would result in 50% reduction in incidences of scalding.

For new construction, the total annual societal problem cost of scalding to Canada is estimated to be $8.4M to $50M (based on 168 and 1000 incidents respectively). The total annual societal solution benefit to Canada is estimated to be $0.7M to $4.2M. The major portion of these benefits relates to addressing stand-alone bathtubs. This is based on $0.1M per patient per year over the lifetime of that patient. The estimated annual cost to achieve this range of benefits is $48M to $119M (Page 36 of Agenda package of meeting #2, Page 4 of Second minutes). This estimated cost does not include out-patient care, which could increase the total annual societal solution benefit.

With respect to legionella disease, there is no impact (cost or benefit).

Enforcement implications:
The wording of this requirement will not impact on the workload of the code authorities to ensure compliance with the code requirements.

Appendix Note for Proposed Article 2.10.7.:

A-2.10.7. Maximum Hot Water Temperature.
Hot water delivered at 60°C will severely burn human skin in 1 to 5 seconds. At 49°C, the time for a full thickness scald burn to occur is 10 minutes. Children, elderly persons and persons with disabilities are most at risk.

Storing water at temperatures below 60°C in the hot water tank or in the delivery system will lead to the survival or growth of legionella bacteria. This concern should be addressed in designing hot water delivery systems. If water is stored at 60°C or higher, bacteria contamination of the hot water delivery system is minimized.

To prevent scalding and thermal shock in a shower, Sentence (1) requires that it be installed with a pressure balanced, thermostatic, or combination pressure-balanced thermostatic-mixing valve with a maximum water outlet temperature of 49°C. Sentence 2.10.6.(1) of the NPC 95 requires that such valves conform to the CSA B125 Standard.

Protection must also be provided in a bathtub or lavatory, as required by Sentence (2). Any device used to provide such protection would also be required to conform to the CSA B125 Standard, as required by Sentence 2.10.6.(1).

These requirements apply to all occupancies. They are not limited to residential occupancies.

The water outlet temperature at other fixtures, such as a sink, laundry tray or bidet, is not controlled by Article 2.10.7.

Sentence (3) addresses legionella. Setting the water heater thermostat at the regulated temperature will assist in controlling the proliferation of the bacteria. The difference in thermostat temperature settings accommodates the variation of the stored water temperature in these different types of tanks due to their current design.

In hot water systems with a re-circulating loop, Sentence (4) requires that provision be made to keep the temperature of the water in the loop at the minimum tank temperature, to reduce the probability of legionella bacteria growth in the piping.

The TG addressed the issue of "retrofit" and made the following statement.

Retrofit Situations:
Philosophically, this Task Group is supportive of applying the proposed code amendments in retrofit situations. At the same time, it is recognized that this cannot be covered in the Code the way it is administered. In order to deal with this, the authority having jurisdiction must determine how they are going to deal with and enforce these requirements if they feel this is necessary.

However, the TG has reservations regarding the practicality of applying the proposed revisions to existing stock. Although a cost benefit analysis was not done on retrofit, preliminary numbers indicate that the cost benefit ratio is higher than that for new construction.

CONCLUSIONS

The task group has fulfilled its terms of reference in developing language for proposed changes to the NPC, has drafted a statement related to its position on retrofits and provided guidance on efforts to educate and inform code users.

Acknowledgements:

I sincerely appreciate the technical support provided by the members of the Task Group and the staff of NRC Codes, Raman Chauhan and Cathy Taraschuk in arriving at these recommendations. The valuable contributions made by the visitors at each meeting are also recognized.

Appendix B

Standing Committee on Building and Plumbing Services

Task Group on Hot Water Delivery in Buildings
Terms of Reference

BACKGROUND:

In February 2001 the Commission was informed that the Canadian Medical Association was urging provincial and territorial governments to amend existing building and plumbing codes to require the default setting of new residential hot water heating devices to a maximum of 49^{o} Celsius to address the safety of children and elderly being scalded in significant numbers.

In consultation with the provinces and territories the CCBFC Executive Committee in August 2001 agreed to recommend to the Commission that it support a maximum hot water heating device setting of 49^{o} Celsius in principle.

In October 2001 the Commission members were in support to have the thermostat of a hot water heater storage tank pre-set at the factory at 49^{o} Celsius and that a proposed technical change to the National Building Code and the National Plumbing Code be developed by the Standing Committee on Building and Plumbing Services (SC-BPS) for public review.

In April 2002 Executive Committee was informed by manufacturers that they support reducing scalding, but warned that hot water heating and storage tank thermostat should not be used to limit the temperature at the outlet to 49^{o} Celsius, as this increases the risk of legionella contamination in electric water heating devices. The industry suggested that it would be better to maintain the tank water temperature higher and install an in-line thermostatic mixing valve between the water heating device and the rest of the residential occupancy to deliver water at 49^{o} Celsius.

The Executive Committee felt that there was a need for a broader review and recommended that the technical change of the standing committee follow the normal process of public review, with the expectation that this review would result in proposals to revise the technical change that would resolve the identified issues.

The SC-BPS prepared a revised technical change and Appendix Note for the National Plumbing Code for public review in the spring of 2003. Comments both positive and negative were considered at the September 2003 meeting of the SC-BPS. The SC-BPS revised the wording of the technical change and its Appendix Note to resolve technical concerns from industry and it recommended to the CCBFC that the proposed technical change be issued as an Interim Change to the 1995 National Plumbing Code.

Both the proposed technical change to the National Plumbing Code and its status as an Interim Change were balloted to the Commission in February 2004. An unusually high number of negative ballots (approximately 25%) were returned on both questions. The Commission in April 2004 concluded that the negative ballots could not be resolved without further study and requested that an ad hoc technical group be formed to develop a recommended solution.

The ad hoc technical group discussed this by teleconference during May and June 2004 and recommended proposed changes and a revised Appendix Note that were considered by the CCBFC Executive Committee in June 2004. The revised technical changes included a requirement that the hot water storage tank thermostat not be used as the temperature regulating device, and revisions to the Appendix Note highlighted the concerns with legionella in the storage tank if the temperature was not kept sufficiently high. The Executive Committee agreed that the technical change be issued as a letter ballot for Commission approval, including its status as an Interim Change to the 1995 National Plumbing Code.

Appendix B

The CCBFC Executive Committee in September 2004 felt that the negative and affirmative ballots with comments raised significant issues. The Executive Committee concluded that new information on the risks of legionella in hot water storage tanks, the costs and enforcement difficulties of implementing the technical change, the reliability of the hot water heating and storage technology and the reliability of thermostatic mixing valves called into question the overall results of the letter ballot. The Executive Committee recommended that the results of the letter ballot be set aside, the proposed technical changes be withdrawn and that a task group led by the Standing Committee on Building and Plumbing Services be formed, with broad stakeholder representation, to find an effective technical solution.

The letter ballot was successful. A national task group led by the Standing Committee on Building and Plumbing Services will commence its work before the end of 2004.

OBJECTIVES:
To examine the health and safety risks associated with hot water delivery in buildings and make recommendations to the SCBPS.

TASKS:
The TG will
a) analyze and assess health and safety risks associated with hot water delivery in buildings by examining the following concerns, including but not limited to:

- reviewing medical information, statistics and circumstances of injuries related to scalding
- reviewing medical information, statistics and circumstances of legionella contaminations
- determining demographics and occupancies that are most at risk.

b) review relevant requirements in standards, the NPC, the NBC, and in other countries

c) develop alternatives

d) examine technical alternatives to consider:

- health and safety issues
- technical feasibility and reliability
- cost implications
- enforcement implications
- retrofit situations.

e) make recommendations to the SCBPS, including but not limited to:

- drafting appropriate code changes
- examining implications on reference standards
- examining exceptions to be considered.

Appendix B

MEMBERSHIP:

Chair: Arnold Knapp (SCBPS member)

Membership:

Category	Name	Region	Remarks
Chair	Arnold Knapp	National	SCBPS Member
Provincial Regulator	Alek Antoniuk	Ontario	
Provincial Regulator	B. Lagueux	Quebec	SCBPS - Member
Municipal Regulator	Garry Davis	Ontario	Municipal official
Health Canada	France Lemieux	National	
Health Quebec	Benoit Levesque	Quebec	
Safe Kids	Rebecca Nesdale-Tucker	National	
Consultant	Ken Newbert	BC	SCBPS - Chair
Utilities	Robert Nault (Hydro)	Quebec	Consultant
	John Krill (Union Energy)	Ontario	User/Consumer/contractor
Industry	Sally Remedios	National	(CIPH/faucet industry)
	Claude Lesage	National	(CIPH/heater mfr.)
Standards	Wasim Hassan	National	Chair of Tech. Ctee. On water heaters
Contractor	Brad Diggens	Prairies	Calgary Contractor
CCC Staff Advisor	Raman B. Chauhan		

CORRESPONDING MEMBERS:
CHBA, CIPH, CSA (staff), OPIA, provincial health authorities, equipment manufacturers, mixing valve suppliers, gas and hydro utilities, etc.

RESOURCES
Codes Staff: Raman B. Chauhan

No of meetings: 3 (January, February and March 2005)
(3 face-to-face meetings, First meeting – 2 days, Second and Third meeting could be one day each.)

Target completion:
March 2005