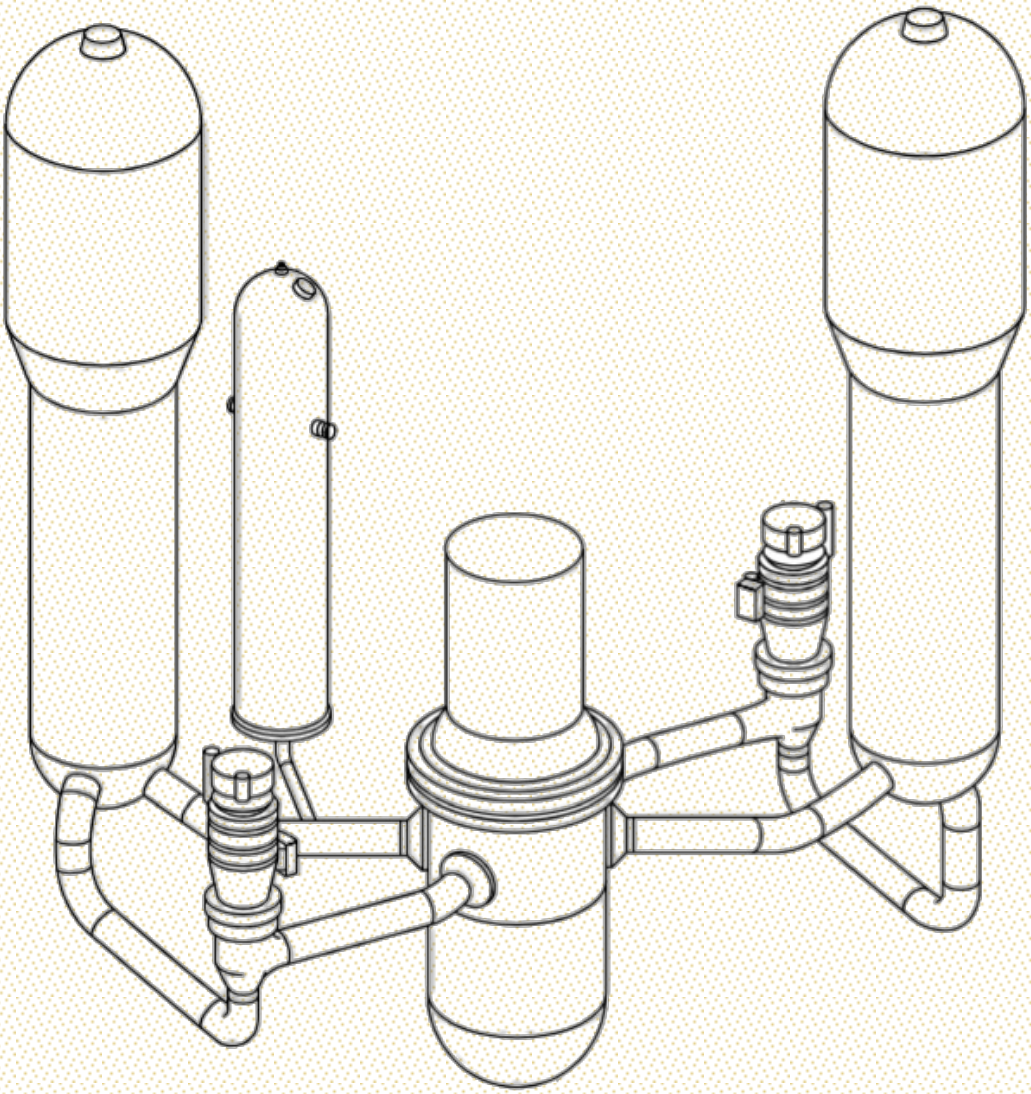

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Evaluation of Simplified Nuclear Power Plant Simulator in Case of a Main Steam Line Break

Dissertação de Mestrado em Engenharia Eletrotécnica e de Computadores

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Evaluation of Simplified Nuclear Power Plant Simulator in Case of a Main Steam Line Break

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Coimbra, Setembro de 2016

This work is dedicated to my mother....

Acknowledgment

I want to acknowledge first to my family mainly my parents and my brother, for everything that they give for me all this years, because without them I could never finish this journey.

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Abstract

This thesis presents a simplified simulation of a main steam line break (MSLB) in a nuclear power plant with two loops and a pressurized water reactor (PWR). The plant model used in this work is a generic two-loop PWR with inverted U-bend steam generators and dry containment system, with thermal output in the neighbourhood of 1800 MWt (600 MWe).

The simulations are conducted by using the software Personal Computer Transient Analyser (PCTran) using all the default parameters for this kind of reactor focusing to a steam line break, which is one of design basis accidents, which the plant can normally withstand.

The thesis is based on two main simulations, a small steam line break with diameter of 4,4 inch (11,3 cm), and a larger with 14 inch (35,7 cm).

During the simulations we can observe the values of parameters that characterise the transient and its timing, from the beginning of the event through the reactor trip and all the main events after the reactor trip. A comparison is made between the two simulations, to understand the differences in each scenario.

In addition, the comparisons are made between the obtained simulations and the similar simulations performed with more detailed computer codes, which are actually used for safety analysis.

The main conclusion after these two simulations is that the safety systems act as expected. The emergency cooling systems that have the purpose of removing decay heat after the reactor shutdown went into action, so the plant remains in a safe condition.

The results of the analysis show that simplified simulator can be effectively used for education purposes.

At the larger break, the timely changes of parameters like temperatures (Cold Leg and Hot Leg), steam flow in the SGs, pressures and in the end reactivity are faster as it is the case of the smaller break. Consequently, the reactor trip is initiated sooner as it is the case of the smaller break. The main parameters behave similarly as they do in safety analysis. Small differences exist in values of certain parameters, but their overall curves over the observed time intervals are similar to their respective curves in the safety analysis.

Keywords: Main Steam Line Break, Pressurized Water Reactor, Nuclear Power Plant, Safety Analysis, Safety Functions, Decay Heat.

Resumo

Nesta dissertação é apresentada a simulação simplificada de uma rutura na conduta principal de vapor de uma central nuclear de dois circuitos de permutação de calor e reator de água pressurizada. O modelo de central usado neste trabalho, é um modelo genérico de uma central de água pressurizada com dois circuitos de permutação de calor, com geradores de vapor de tipo tubo em U invertido e com sistema de contenção do reator, seco. Com uma potencia térmica de aproximadamente 1800 MWt (600 MWe).

As simulações foram realizadas usando o software Personal Computer Transient Analyser (PCTran), utilizando todos os parâmetros genéricos para este tipo de reator e focando-se numa rutura na conduta principal de vapor, que é um dos acidentes de base de projeto, com o qual a central pode normalmente suportar.

Esta dissertação é baseada em duas simulações principais, uma rutura pequena de diâmetro 4,4 inch (11,3 cm), e uma maior de cerca de 14 inch (35,7 cm).

Durante as simulações podemos observar todos os valores dos parâmetros que caracterizam o transitório e o seu timing, desde o inicio do evento passando pelo desligamento de emergência do reator e também todos as ocorrências principais depois do mesmo ser desligado.

Também é feita uma comparação entre as duas simulações, para perceber as diferenças entre cada cenário.

Adicionalmente são feitas comparações entre as simulações obtidas e simulações similares realizadas com códigos de computador mais detalhados, que são efetivamente utilizadas para análise de segurança.

A conclusão principal obtida depois destas duas simulações é de que os sistemas de segurança atuam como esperado. Os sistemas de refrigeração de emergência que têm como função remover o calor residual que continua a ser produzido depois do reator ser desligado entram em ação, ficando a central nas devidas condições de segurança.

Os resultados da analise mostram que o simulador simplificado pode ser usado efetivamente para fins educativos.

Aquando da rutura maior, as variações em parâmetros como temperaturas (Cold Leg e Hot Leg), fluxo de vapor nos geradores de vapor, pressões e por fim a reatividade, são mais rápidos quando comparados com a rutura pequena. Consequentemente, o desligamento do reator é iniciado mais cedo do que no caso da rutura pequena.

Os parâmetros principais têm comportamento semelhante ao das analises de segurança. Existem pequenas diferenças nos valores de alguns parâmetros, mas globalmente durante os intervalos de tempo observados, as curvas são similares as mesmas na analise de segurança.

Palavras-chave: Rutura Na Conduta Principal De Vapor, Reator Nuclear De Água Pressurizada, Central Nuclear, Analise de Segurança, Funções De Segurança Nuclear, Calor Residual.

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Abbreviations and Symbols

Abbreviations

IAEA	International Atomic Energy Agency
NPP	Nuclear Power Plant
LOCA	Loss of Coolant Accident
PWR	Pressurized water reactor
LWR	Light Water reactor
MSLB	Main Steam Line Break
SG	Steam Generator
RCS	Reactor Coolant System
EFW	Emergency Feedwater
HPSI	High-Pressure Safety Injection
LPSI	Low Pressure Safety Injection
ACC	Accumulators
MSIVs	Main Steam Isolation Valves
RCS	Reactor Coolant System
SCRAM	Fast Emergency Shutdown
PZR	Pressurizer
PCTran	Personal Computer Transient Analyser
ECCS	Emergency Core Cooling Systems
FWIV	Feed Water Isolation Valves
OECD	Organisation for Economic Co-operation and Development
SFAS	Safety Feature Actuation System

Symbols

MWe	Megawatt Electrical
MWt	Megawatt Thermal
MW	Megawatt
TWh	Terawatt Hour
BAR	Bar (unit)

t/hr	Tonne per Hour
ºC	Degrees Celsius
K	Kelvin
Kg/s	Kilogram Per Second
MPa	Mega Pascal

1 Introduction

In this chapter, the motivations for this work are presented together with main steam line break explanation, the objectives of this simulation and a brief description of the document structure.

1. Introduction

1.1. Background

Today the environmental problems are one of the main issues worldwide, one of the principal factors are the greenhouse gas emissions that are still increasing around the world. Because the majority of the energy is produced from fossil fuels that produce large amounts of emissions, the electrical energy production from fossil fuel started to be looked from a different view than the past. Another thing to have in mind is that this kind of fuels are finite and started to be scarce and expensive. Because of these problems, the investment in carbon free or low-carbon power sources, like nuclear power, needs to be taken in consideration for the future.

Many countries, particularly among the Organisation for Economic Co-operation and Development (OECD) have created environmental policies and regulations to reduce greenhouse gas emissions from electric power plants by decreasing the use of fossil fuels. As a result, the role of coal as the dominant fuel for electric power plants is declining. Because of this policy, nuclear power and natural gas are important sources of electricity generation, together with the renewable energy sources.

The development of new nuclear generating capacity looks a good option to reduce gas emissions, and also a good source of price competitive electrical energy.

The nuclear power is already today one of the main sources of electricity production, representing 10,6 % (2478 TWh) of the electricity produced worldwide in 2015 [8].

From the most recent studies [9], the electricity generation from nuclear power will increase from 2,3 trillion kWh in 2012 to 3,1 trillion kWh in 2020 and to 4,5 trillion kWh in 2040, the nuclear power is the world's second fastest-growing energy source, with consumption increasing by 2,3%/year over that period [9].

Safety of nuclear power plants is assured by strict regulation, which is based on technical standards and serious people. The safety analyses represent the basis for the safety analysis report, which is the main document assuring safety of a particular nuclear power plant.

1.2. Scope

This thesis has the main purpose to simulate a main steam line break initiating event and the transient that follows to put the nuclear power plant in a safe state, to analyse the parameters obtained during the transient and to compare the values of the parameters with the values obtained with the safety analyses.

To have a better view about the main steam line break, first a small break with diameter of 4,4 inch (11,3 cm) and 100 cm^2 of area is detailed analysed, and after a 10 times bigger fault with 14 inch (35,7 cm) of diameter and 1000 cm^2 of area, is also studied. This comparison is important for understanding the differences between a smaller and a larger break, in terms of timing of transient and the related parameters, and the responses of the safety.

The data related to temperatures (Cold and Hot leg and average), pressures, water levels and also neutron flux are detailed studied and also her evolution during the transient is analysed and compared between the two cases.

After this, a comparison is made between the parameters and results obtained with the simulator used in this work (PCTran) during the simulation of a large MSLB (1000 cm^2), with a more detailed models, obtained from 3-D neutronics (coupled code RELAP5/QUABOX/CUBBOX) and point kinetics (RELAP5/mod3.2.2) calculations of MSLB. In this comparison, we can see, how accurate are the results and if the main effects are observed from the time variability of the parameters. Based on the comparison, the objective of the thesis is to verify, if the simplified simulator is good enough that it can be used for the educational purposes.

1.3. Outline

This work is composed by seven chapters, references and appendix. In this chapter, the motivations for this work are presented together with main steam line break explanation, the objectives of this simulation and a brief description of the document structure.

In the second chapter, a description and the basic facts about a nuclear power reactor are made. First starting by describing the basic main components of a generic power reactor and then explaining the operation of a pressurized water reactor (PWR), the kind of reactor studied in this work.

The third chapter is about the safety of a nuclear power plant (NPP), in special the safety objectives during the construction and operation of a NPP.

In the fourth chapter, the safety systems are presented. The control of the reactor during different kind of operations and the most important aspects of NPP safety are explained: the importance of cooling the reactor's core and the removal of the decay heat is also explained.

Fifth chapter is about the importance of safety analysis and transient simulations. A description of MSLB is presented. A description of the simulator, its capabilities and the default parameters used in the simulation are described.

The sixth chapter is the main core of the work. The analyses and results of the simulation of a main steam line break are presented. Two sizes of the main stream line break are analysed and compared, where we can see the visible differences between the two cases. In the end of this chapter, a comparison with more accurate results from the safety analysis published in ref. [5] is made.

In the end, the last chapter is about the conclusions obtained in this thesis.

2 Nuclear Power Reactors

In this chapter, a description and the basic facts about a nuclear power reactor are made. First starting by describing the basic main components of a generic power reactor and then explaining the operation of a pressurized water reactor (PWR), the kind of reactor studied in this work.

2. Nuclear Power Reactors

In a nuclear reactor, the production, control and release of energy comes from splitting the atoms of certain elements. The nuclear power reactor releases the energy as heat to make steam to generate electricity.

The principles for using nuclear power to produce electricity are similar for most types of reactors. The energy released from fission, for example uranium atoms, of the fuel is used as heat source in either a gas or water, and produce steam. The steam is used to drive the turbines which produce electricity, like in the fossil fuel plants.

Today the reactors derived from designs, originally developed for propelling submarines and large naval ships, represent about 85% of the world's nuclear electricity generated. The main design is the pressurised water reactor (PWR) which has water at over 300°C under pressure in its primary system, reactor coolant system, and generates steam in a secondary system. In this type of reactor, the water is used as both coolant and moderator, to slow neutrons and transfer the heat from the reactor core to the secondary loop. Because water normally boils at lower temperature (100°C), the nuclear power plants (NPP) have robust steel pressure vessels or tubes to enable the higher operating temperature at higher pressure (e.g. 155 bars). The NPP with two loop PWR is considered in this thesis.

2.1. Components of a Nuclear Reactor

2.1.1. Fuel

Uranium is the basic fuel used. Usually pellets of uranium oxide (UO_2) are arranged in tubes of fuel rods. The fuel rods are arranged into fuel assemblies in the reactor core. In a new reactor with new fuel, to get the reaction going, a neutron source is needed. Usually this source is beryllium mixed with polonium, radium or other alpha-emitter. Alpha particles from the decay cause a release of neutrons from the beryllium as it turns to carbon-12.

2.1.2. Moderator

The moderator is a material in the core which slows down the neutrons. In a PWR, the water is the moderator and is at the same time the coolant and the heat transfer media, but in

other nuclear reactor the moderator may be heavy water or graphite. In this study case, the moderator is water.

2.1.3. Control Rods

The control rods are made using the neutron-absorbing materials such as silver, cadmium, hafnium or indium, and are inserted or withdrawn from the core to control the rate of reaction, or to stop it.

2.1.4. Coolant

The coolant is a fluid that circulates through the core to transfer the heat from it to the secondary loop. In light water reactors, such is the PWR, the water moderator works also as primary coolant. So the coolant is one of the main components in a nuclear power plant (NPP).

2.1.5. Pressure Vessel

A strong and robust steel vessel is used to contain the reactor core and moderator/coolant.

2.1.6. Steam Generator (SG)

The steam generator is part of the cooling system of PWR, where the high-pressure primary coolant that transport the heat from the reactor, makes the steam for the turbines in a secondary system. Essentially is a heat exchanger between primary and secondary system.

Pressurized water reactors have up to four loops, each with a steam generator (in the study case, a 2 loop reactor with 2 steam generators is used).

The secondary water must flow through the support structures for the tubes. All the systems need to be designed in the way, that the tubes don't vibrate too much and that the water is chemically clean to avoid corrosion.

2.1.7. Pressurizer (PZR)

The pressurizer (PZR) is the component in the reactor coolant system which controls the system pressure. Pressure is controlled by the use of electrical heaters, pressurizer spray, power operated relief valves, and safety valves.

The PZR operates with a mixture of steam and water in equilibrium and when the pressure starts to deviate from the desired value, the heaters or sprays will actuate to bring pressure back to the normal operating point.

2.1.8. Containment

The containment is the structure that surround the reactor and associated steam generators it is designed to protect the reactor from outside intrusion, and avoid that the effects of radiation, in case of any serious accident inside, to spread outside. It is typically a very strong and large concrete/steel structure.

Figure 2.1 shows the main components of a nuclear power plant.

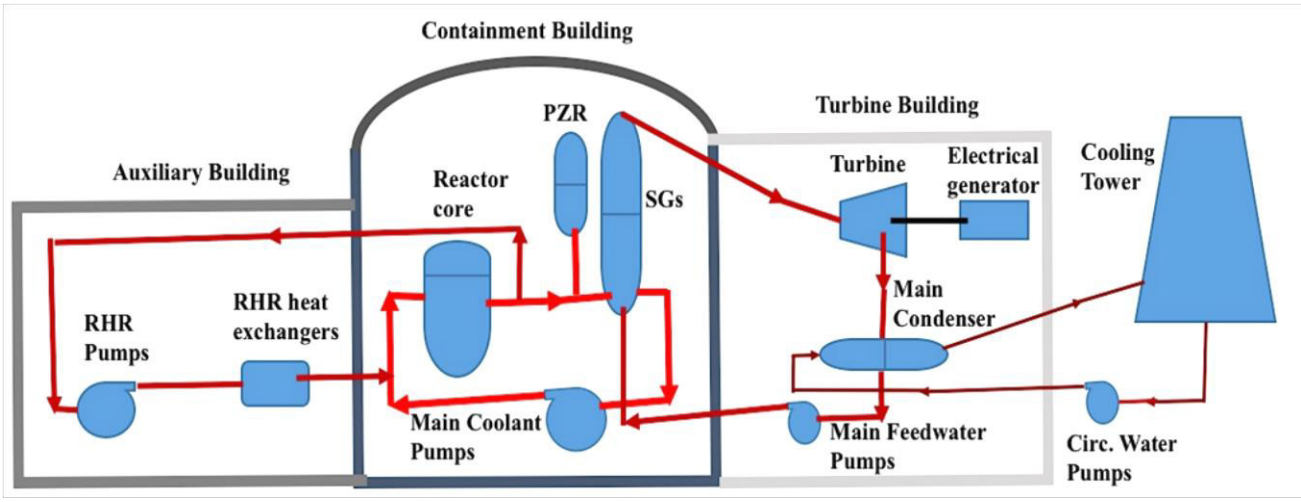

Figure 2.1 - Representation of the main components of a nuclear power plant [4].

2.2. Pressurised Water Reactor (PWR)

The PWR is the most common type of reactor with over 230 of NPP with it in use for power generation. The PWR was designed originally as a submarine power plant. In the PWRs the regular water is used as both, coolant and moderator. The design is distinguished by having a primary cooling system which flows through the core of the reactor under very high pressure, and a secondary system in which steam is generated to drive the turbine.

Water flowing through the reactor core reaches about 325°C and the pressure is about 155 bars to prevent the water boiling in the primary system. Pressure is maintained by the pressuriser. Because the water is also the moderator in the primary system, if any of it would turn to steam the fission reaction would slow down. This negative feedback effect is one of the most important safety features of the PWR.

The secondary system is under less pressure and the water there boils in the heat exchangers called the steam generators. The steam that is generated drives the turbine to produce electricity, is then condensed in condenser and then return to the steam generators.

Figure 2.2 shows the main components of a pressurised water reactor with two steam generators, two reactor coolant pumps, and a pressurizer.

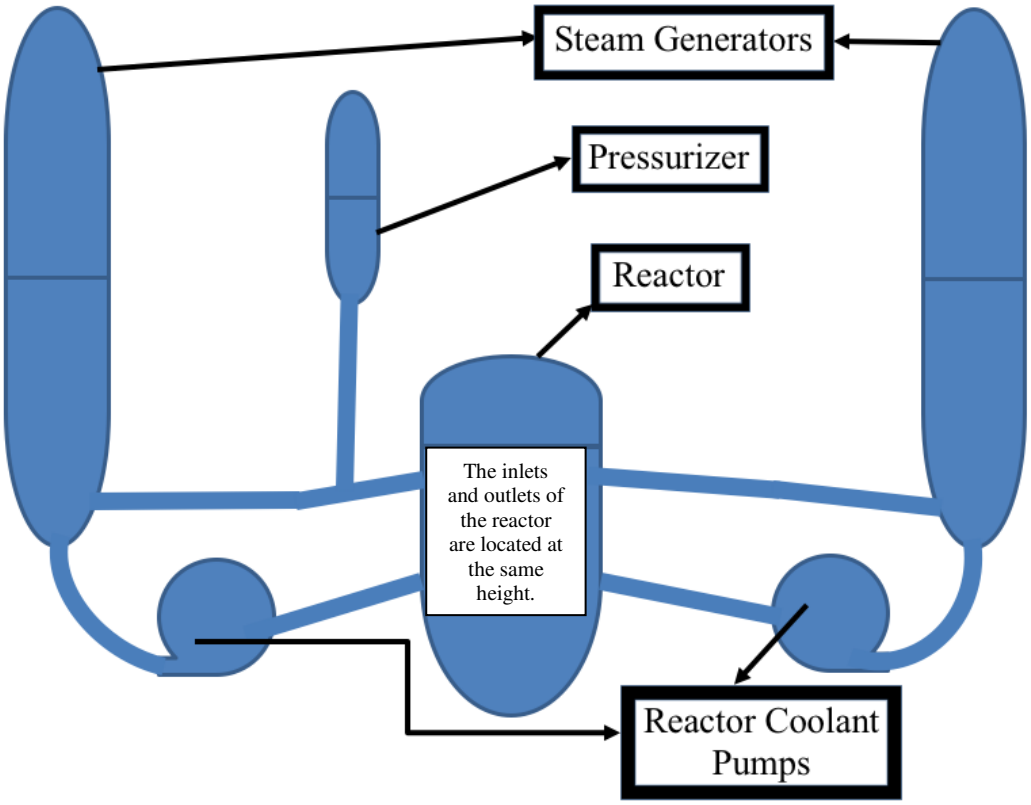

Figure 2.2 - Representation of a two-loop PWR [4].

3 Safety of Nuclear Power Plants

This chapter is about the safety of a nuclear power plant (NPP) with focus to the safety objectives which are important in all phases of the NPP life cycle from design, construction, commissioning to operation and maintenance and decommissioning.

3. Safety of Nuclear Power Plants

Radioactivity is a natural phenomenon, so the natural sources of radiation are part of the environment and can be found everywhere. Radioactive substances and radiation are used in many applications, from medicine, power generation, different kinds of industries and agriculture where the use of radiation helps to preserve nearly 40 different varieties of food.

In all works that involve risk to the environment and the public health, like the operation of nuclear installations, the production, transport, use of radioactive material and the management of radioactive waste, the related activities must therefore be subjected to the very rigorous standards of safety.

With the essential purpose of protecting people and the environment, from the possible effects of ionizing radiation, the IAEA (International Atomic Energy Agency) established a series of safety principles, and guides about the requirements and measures to control the radiation exposure of people and the release of radioactive material to the environment. These principles have the main function of restricting the likelihood of events that might lead to a loss of control over a nuclear reactor core, nuclear chain reaction, radioactive sources or any other source of radiation. They are made also with the intention of mitigating the consequences of undesired events, if they occur. An integrated and consistent set of Safety Requirements is established that must be met to ensure the protection of people and the environment, both now and in the future. If the requirements are not met, measures must be taken to reach or restore the required level of safety.

During the design of a nuclear power plant (NPP), to achieve the highest level of safety that can be achieved, some measures need to be taken, consistent with criteria and safety objectives that we can see next [1]:

- Prevent accidents with harmful consequences resulting from a loss of control over the reactor core or other sources of radiation, and to mitigate the consequences of any accidents that do occur;
- Ensure that for all accidents taken into account in the design of the installation, any radiological consequences would be below the relevant limits and would be kept as low as reasonably achievable;
- Ensure that the likelihood of occurrence of an accident with serious radiological consequences is extremely low and that the radiological consequences of such an accident would be mitigated to the fullest extent practicable.

4 Nuclear Power Plant Safety Functions

In this fourth chapter, the safety systems are presented. The control of the reactor during different kind of operations and the most important aspects of NPP safety are explained. The importance of cooling the reactor's core and the removal of the decay heat is also explained.

4. Nuclear Power Plant Safety Functions

The nuclear power plants have multiple robust safety systems designed to prevent accidents and to mitigate the consequences if they occur. These systems perform three fundamental safety functions, controlling the reactor, cooling the fuel and containing the radioactive substances at the place of their creation, they are essential in a NPP. All of these systems are maintained and tested regularly, and upgraded when necessary, to ensure that the plants meet the safety standards established by the International Atomic Energy Agency and by national safety regulatory authority.

In next subchapters, these safety functions are described.

4.1. Control The Reactor

4.1.1. Normal Operation of the NPP

Controlling the reactor in a nuclear power plant involves increase, decrease and stop the chain reaction if is needed during the operation of NPP.

When the reactor is operating, the chain reaction (power level) is controlled by the neutron absorbing control rods and by the eventual insertion of soluble chemical neutron absorber (boric acid) in the reactor coolant, usually the control is made by moving the adjuster rods, and is used to control the output power. Sensitive and redundant detectors are essential for monitoring different aspects, like temperature, pressure, water level and the reactor power level and ensure that the conditions are kept under control.

When necessary, reactor can safely and automatically shut down within seconds, by the gravitational fall of the control rods or the operators shut the reactor manually. This feature is fundamental, if an eventual emergency shutdown (reactor trip or in some literature: reactor scram) is required.

4.1.2. Shutdown and Restart

The shutdown system is made up of rods that drop and stop the chain reaction if something irregular is detected, in order to prevent core damage. A reactor trip causes all the control rods to drop into the reactor core, and shut down the plant in a very short time (in seconds) [2].

This system can work without power or operator intervention. However, it can also be manually activated. This main system is regularly and safely tested.

After a reactor shutdown, it is impossible accidentally to restart it again. The reactor needs to be manually restarted by the operators in the control room after getting approval for the regulatory authority based on performing all required matters before plant start-up.

4.2. Cooling The Fuel

The main function of the coolant in an NPP is to transfer energy in form of heat, from the hot fuel in the reactor's core to the turbine, through intermediate steps. When the power plant is in normal operation, the cooling occurs during the energy transfer. However, after the reactor's shut down, cooling has a special additional importance. Radioactive decay causes heat production to continue even after the reactor trip and electricity generation has stopped. So also after shutdown it's still essential to maintain cooling to avoid damage of the core, like melting.

4.2.1. Decay Heat

Following a shutdown, the amount of energy produced by the reactor decreases rapidly. The nuclear fuel, however, continues to produce some heat and must be cooled. That heat is called decay heat and is the consequence of the decay of radionuclides in the fuel, that continues to generate heat by their spontaneous decay. It represents a small fraction of the heat produced during normal operation, usually seven percent of the maximum thermal heat output, one second after the reactor shut down and decreasing. After 24 hours, it represents approximately 0,5 percent of the nominal thermal heat. This may not seem lot of heat, but it is, in this scale. A reactor of a 600 MWe power electricity output has about 1800 MWt of thermal power. One day after shutdown it will still producing 8,5 MWt of power inside the reactor pressure vessel, enough to boil thousands litters of water from 20 ºC to boiling point in slightly less than 24 hours, and 100 days still producing 1,3 MWt of heat.

One perspective of the power related to the decay heat along the time (100 days), can be viewed in the next figure that represents the power produced by this heat in an 1800 MWt reactor that was operating during 1 year before the shutdown [3], [6], [7].

Figure 2.3 shows the power related to decay heat of a 600 MWe (1800 MWt) reactor (approximately).

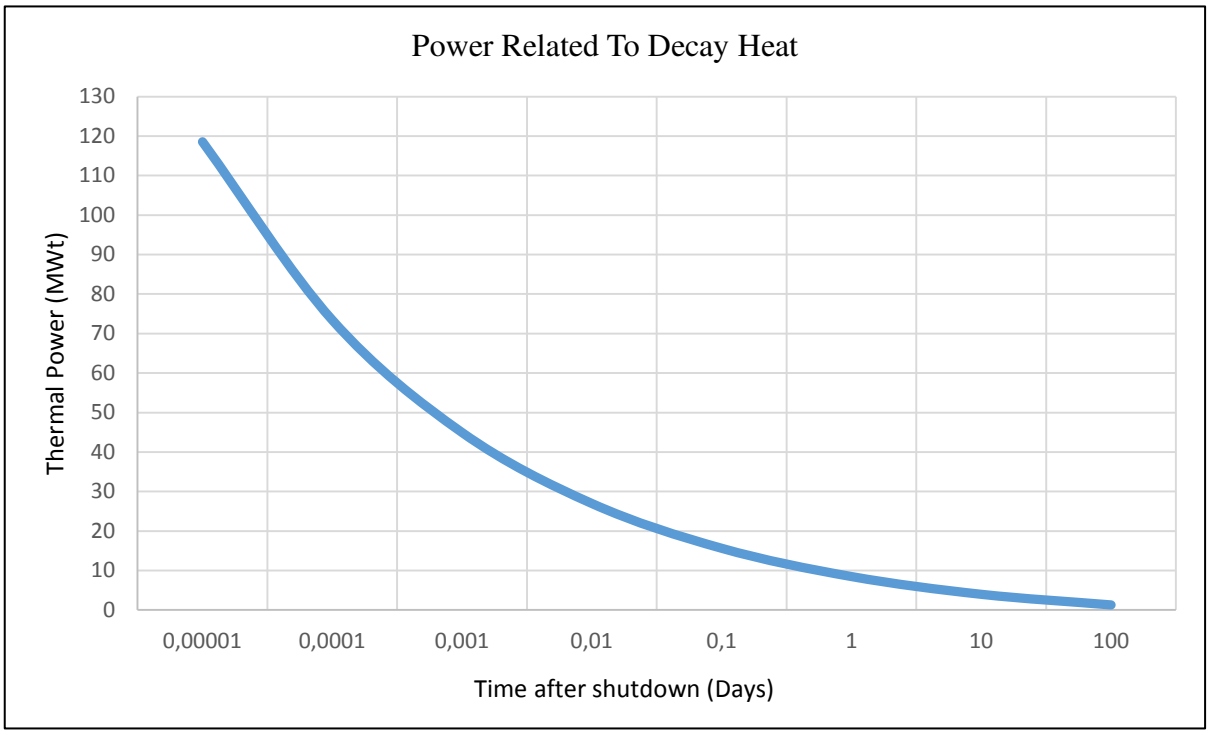

Figure 4.1 – Power related to decay heat of a 600 MWe.

Decay heat is the principal reason of safety measures in NPPs, and because of this, the NPPs have several protection and safety systems, to make sure that in all circumstances this heat is removed from the core. The reactor emergency core cooling systems remove the heat from the core after the reactor shutdown. And after planned shutdown of the plant, this function is performed by the residual heat removal system.

4.2.2. Main Cooling Systems

During normal operation of the PWR, a large flow of water pass through the reactor vessel, cools the reactor core and transfer the heat to the secondary side. This flow can be disrupted by a break in a pipe, failure of valves or pumps that are related to the primary system, reactor coolant system. Such events that cause disruptions on the normal cooling system operation in the primary system are named loss-of-coolant accidents (LOCAs). To prevent an eventual overheating of the fuel, the light water reactors have the emergency core-cooling systems that need to maintain water flow to the reactor core in such case.

4.2.3. Shutdown Cooling System

During a planned shutdown, for example for maintenance, a simpler cooling system is used to cool the core. It requires low power and allows the primary coolant system to be partly drained to perform inspection and the maintenance work (e.g., inspection of the steam generator tubes, replacement of pump components or valves).

4.2.4. Power Supplies

The cooling systems are supplied by electrical pumps, which under normal operation get their electrical power from the power system of the NPP, which is connected to the offsite power. But in case of loss of the offsite power, NPPs are also equipped with multiple sources of backup power, onsite and offsite. The onsite emergency power is produced by the plant itself and includes several emergency power diesel generators.

4.2.5. Coolant Natural Circulation

Natural circulation is one of the passive safety systems of pressurized water reactors (PWRs). In PWRs even without an active pump, there is a natural circulation flow through the reactor, but to achieve this, the steam generators need to be filled with cool water. This natural flow is not sufficient to remove the heat being generated when the reactor is at power, but the natural circulation flow can help [4]. In advanced PWR with passive safety systems, the features are improved, so the safety can be maintained even without active systems.

5 Safety Analysis

This chapter discusses safety analysis and transient simulations. A description of MSLB is presented. A description of the simulator, its capabilities and the default parameters used in the simulation are described.

5. Safety Analysis

Safety analysis is an essential element of a safety assessment of a NPP. It is an analytical study used to demonstrate how safety requirements are met for a broad range of operating conditions and various initiating events. Deterministic and probabilistic analyses are part of safety analysis and are also essential in support of the design, commissioning and operation or decommissioning of a nuclear power plant. The computer simulations of design basic accidents (a kind of accidents that the NPPs must be designed and built to handle, without loss to the systems, structures and components necessary to safety of people and the environment), are essential to improve the safety and prevent future accidents. One of the main design basic accidents with crucial importance of study is the main steam line break (MSLB). Simulation of a main steam line break is important from the perspective of potential plant damage and related environmental consequences, although the probability of occurrence of such an event is considered to be very small.

5.1. Description of MSLB Transient

As mentioned previously, the reference problem for this work is a simulated MSLB, resulting from the rupture of one steam line near one of the steam generators. This kind of initiating event can be initiated by a partial or full steam line rupture, which can occur either inside (like in this simulation) or outside the containment. The steam line break results in the loss of secondary coolant, and the broken steam generator (SG) depressurises, while the intact SG is isolated when the turbine stop valves are closed. As a result of the break in the steam line, the steam flow rate in the broken SG increases, improving the cooling of the reactor and lowering the average temperature of the core. Because of this, average reactor coolant temperature decreases and the power begins to increase due to the negative feedback effect. The loop with the break has large flow of cooling, while the intact loop receives little or almost nothing throughout the transient.

A reactor trip occurs due to either low reactor coolant pressure or high neutron flux. Following the reactor trip, the turbine trips and the turbine stop valves and feedwater control valves close. Low steam line pressure initiates automatic feedwater isolation, which causes the steam generator associated with the rupture to blow dry. Continued reactor coolant system (RCS) cool-down and decay heat removal would be achieved by emergency feedwater (EFW), which is

in some plants called Auxiliary Feedwater System, Emergency feedwater flows to the intact SG. The High Pressure Safety Injection (HPSI) System may be activated due to low RCS pressure during the cool-down period following a large steam line break.

5.2. The Simulator

The simulator used in this work is Personal Computer Transient Analyser (PCTran). PCTran is a reactor transient and accident simulation software program that operates on a personal computer. Developed in 1985 has been constantly upgrading its performance and expanding its capabilities [10].

The plant model used in this work is a generic two-loop PWR with inverted U-bend steam generators and dry containment system. It could be a Westinghouse, Framatome or KWU design with thermal output of 1800 MWt (600 MWe). One loop with the pressurizer is modelled separately from the other loop. There are a number of PWR plants in the world which belong to this category, e.g. NPP Krsko in Slovenia, NPP Point Beach, NPP Prairie Island and NPP Ginna in the USA and NPP Angra 1 in Brazil.

The PCTAN main display presents the main display with all NPP important equipment (i.e., pumps, valves, and heat exchangers), shown as icons. All the main information (temperatures, pressures, flows and levels of water) are also showed [10].

5.2.1. Main Window

The panels and equipment displayed is consistent with the description of plant systems. We can easily identify the steam generator, the pressurizer, the core and also the main pipes on a NPP. It is also easy to identify and read in real time the main temperatures, pressures, water levels on the different parts and also change some parameters. All of the components on the display are functional, red indicates open or on, green indicates closed or off. Pumps can be started or can be stopped. The valves can be easily opened and closed.

The real control room of a nuclear power plant has hundreds if not thousands of instruments and controls including displays, different sorts of and switches. In PCTran they are reduced to absolute minimum. But the basic principle and characteristics of the simulated advance reactor is present in the display. Figure 5.1 shows the main window of the simulator.

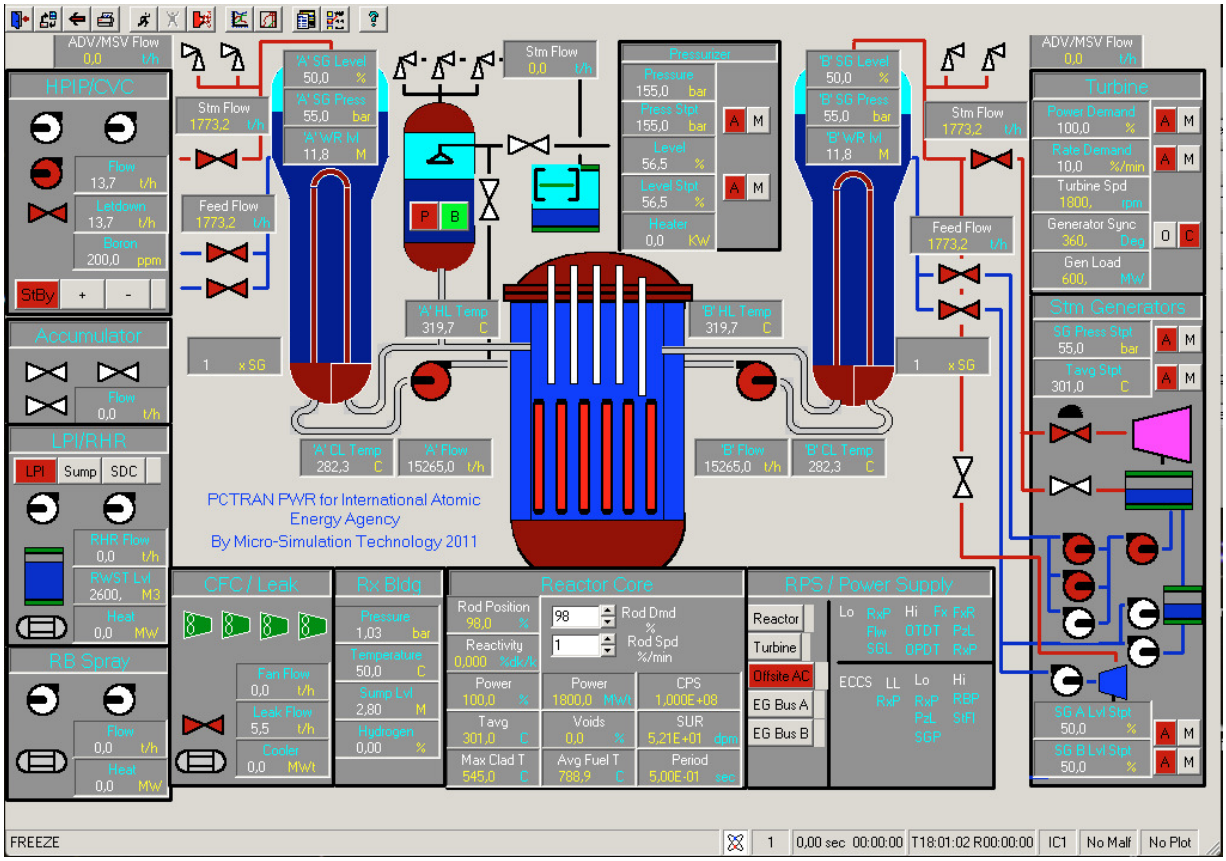

Figure 5.1 - PCTran 6.0.1 Display with initial conditions.

5.2.2. Initiating Events

PCTran comes with the most typical and studied initiating events that can happen in a NPP, despite the likelihood that some of them being considerably rare. These initiating events can be turned on, in the respective menu. There one can change or turn on/off some parameters like ramp time, delay time and severity. After this, the status of the desired initiating event should be checked to "Active" and it's ready to start the respective simulation.

Table 5.1 shows 20 initiating events representing design basis accidents that are considered in PCTran.

Table 5.1 - PCTran initiating events list.

Id. Number	Description	Criteria
1	Loss of Coolant Accident (Hot Leg)	% of 100 cm^2
2	Loss of Coolant Accident (Cold Leg)	% of 100 cm^2

Id. Number	Description	Criteria
3	Steam Line Break Inside Containment	% of 100 cm^2
4	Steam Line Break Outside Containment	% of 100 cm^2
5	Spark Presence for Hydrogen Burn	(Not Used)
6	Loss of AC Power	(Not Used)
7	Loss of Flow (Locked Rotor)	(Not Used)
8	Anticipated Transient Without Trip	(Not Used)
9	Turbine Trip	(Not Used)
10	Steam Generator A Tube Rupture	% of 1 full tube rupture
11	Steam Generator B Tube Rupture	% of 1 full tube rupture
12	Inadvertent Rod Withdrawal	of 1% dk/k withdrawn
13	Inadvertent Rod Insertion	of 1% dk/k inserted
14	Moderator Dilution	of Unborated Injection
15	Load Rejection	of Full Load Rejected
16	Containment Failure or spark for H_2 detonation	% per Day at Design Pressure
17	Fuel Failure at Power	% of Fuel Failed
18	Fuel Handling Accident in Containment	% of Total
19	Fuel Handling Accident in Auxiliary Building	% of Total
20	Letdown Line Break in Aux Building	% of Nominal Letdown flow

The event number 3 “Steam Line Break Inside Containment” is studied here, with different break sections and the default initial conditions.

5.2.3. Initial Conditions

For this work, the typical two loop 1800 MWt (600 MWe) PWR default initial conditions, are considered. These initial conditions contain the basic plant geometric, physics, trip set point and other characteristic data. The reactor rated power, reactor coolant pump heat, decay heat after shutdown, and stored heat from steel piping and uranium oxide are considered.

The pressurizer has heaters, spray, PORV, and safety valves are there for pressure control. Normal makeup (charging) and high-pressure injection (safety injection) are available for inventory control. In addition, the ECCS includes accumulators (Core Flood Tanks) and Low-

Pressure Injection. The steam generator secondary side is normally fed by main feedwater and controlled at a certain level and pressure. After the reactor trip, the main feedwater may be lost and the emergency feedwater can be initiated and controlled while the turbine bypass and atmospheric dump valves control the steam pressure at staggered set points. In addition, steam safety valves relieve pressure at even higher set points.

Table 5.2 shows the initial conditions considered for this work.

Table 5.2 - PCTran, NPP initial conditions.

Parameter	Value	Description
POWER	1800	Rated Thermal Power (Mw)
P0	155	RCS Initial Pressure (Bar)
T0	301	RCS Initial Average Temperature (°C)
WRC0	30530	Total Core Flow Rate (T/Hr)
TCST	15	RCP Coastdown Time (Sec)
RCP	10	Total RCP Heat Input (Mwt)
APORV	11,8	Area of PORV (cm^2) Per Valve
ASAFT	23	Area of Pressurizer Safeties (cm^2) Valves Combined
PORV1	165,2	PORV Open Setpoint (Bar)
PORV2	163,2	PORV Reseat Setpoint (Bar)
SAFT1	176	Safety Valve Open Setpoint (Bar)
SAFT2	175	Safety Valve Reseat Setpoint (Bar)
PHIGH	165,7	High Pressure Reactor Trip Setpoint (Bar)
TEFW0	60	EFW Initiation Delay Time (Sec) After Initiation Signal (Sec)
AL0	0,565	Initial Pressurizer Level (Fraction of Full)
PHPI	129,69	HPI Auto Start Setpoint (Bar)
PSCRAM	132,2	Low Pressure Reactor Trip Setpoint (Bar)
TEMP	25	HPI And EFW Temperature (°C)
PADV	81,8	SG Relief Valves (Atmosp. Dump Valve) Opening Pressure (Bar)
ADV	261,09	SG Relief Valves Total Capacity(T/Hr)
WLD0	13,7	Letdown Flow for Chemical & Volume Control System (CVCC) During Normal Operation (T/Hr)
CHG	30	Charging Flow (T/Hr)
TRIN	5	Rod Insertion Minimum Time (Sec)

Parameter	Value	Description
TROT	2	Rod Withdrawal Minimum Time (Sec)
AKRD	1,333	Reactivity Worth of One Rod ($)
AKCHG	-10	Accumulator/RWST Boron Activity (Pcm/Ppm)
GFW	0,5	Feedwater Controller Constant, a Dimensionless Number
VSG	565	Total SG Volume (M^3)
TBV	0,4	Total TBV Flow Capacity in Fraction of Full Power Steam
HMFW	950	Feedwater Enthalpy at Full Power (Kj/Kg)
TRXT	99999	Reactor Trip Delay Time After Turbine Trip (Sec)
TER1	9,18	Maximum Tavg Error for Steam Dump Control (°C)
EFW	120	EFW Capacity (T/Hr) for Turbine Driven Pump
VPRZ	35	Pressurizer Volume (M^3)
VRCS	180	Total RCS Volume Excluding Pressurizer (M^3)
MSG0	80000	Total SG Water Inventory Including Steam Mass (Kg)
TSG0	280	No-Load Steam Generator Temperature or RC Tavg (°C)
SSMS	170	Reactor Vessel Stainless Steel Mass (Ton)
UO2MS	56	Fuel UO_2 Mass (Ton)
WTR0	114,5	SG Tube Rupture Flow per Tube Break (T/Hr)
PCFT	43	Pressure Set Point for Core Flood Tank Initiation (Bar)
CFT	60	CFT Tank (Accumulator) Total Water Capacity (M^3)
WCF0	35,3	Nominal CFT Flow Rate at Initiation (T/Hr)
PLPI	11,36	LPI System Initiation Pressure (Bar)
TAVGL	281	Low Tavg Set Point for SG Isolation (°C)
ULSG	8,535	Height of SG U-Tubes (M)
HRLV	0,17	Pressurizer Low Level Set Point for Heater Shutoff
SPRY	20	PRZ Spray Flow Capacity (T/Hr)
PSP1	0,6	PRZ Spray Initiation Error (Bar)
PSP2	5	PRZ Spray Maximum Error (Bar)
HTR1	270	PRZ Proportional Heater Capacity (KW)
PHTR1	0	Proportional Heater Initiation Error (Bar)
PHTR2	-1,1	Proportional Heater Error for Full Capacity (Bar)
PHTRB	-1,5	Set Point for Pressure Error to Turn on Backup Heater Capacity (Bar)

Parameter	Value	Description
VTAF	90	RCS Volume to Top of Active Fuel (M^3)
ATAF	7	RCS or Core Cross Section Area at Top Of Fuel (M^2)
LSG0	11,83	SG Wide Range Level at Full Power (M)
PSG100	55	Steam Generator Pressure at 100% Power (Bar)
HTRB	662	Backup Heater Capacity (KW)
LPSG	2	Number of Steam Generator Loops
GSTM	2	Turbine Control Valve And Bypass Valve Gain Constant
TER2	2,78	Deadband for Tavg Steam Dump Control for Load Rejection (°C)
SGHH	82	High-High SG Level for Turbine Trip (%)
ASG1	2,254	SG Lower Section Cross Section Area (M^2)
RLSG	5,1	Range For SG Narrow Range Level Instrument (M)
SGLL	17	Low SG Narrow Range Trip Set Point (%)
CFTN2	28,227	Total Nitrogen Volume in Core Flood Tanks or Accumulators (M^3)
PH(1)	0	The Head Curve for SI Pump Pressures 1st Data Point (Bar)
PH(2)	34	The Head Curve for SI Pump Pressures 2nd Data Point (Bar)
PH(3)	83	The Head Curve for SI Pump Pressures 3rd Data Point (Bar)
PH(4)	125	The Head Curve for SI Pump Pressures 4th Data Point (Bar)
PH(5)	165	The Head Curve for SI Pump Pressures 5th Data Point (Bar)
PH(6)	185	The Head Curve for SI Pump Pressures 6th Data Point (Bar)
PH(7)	280	The Head Curve for SI Pump Pressures 7th Data Point (Bar)
WH(1)	50	The Head Curve for SI Pump Flow 1st Data Point (T/Hr)
WH(2)	45	The Head Curve for SI Pump Flow 2nd Data Point (T/Hr)
WH(3)	40	The Head Curve for SI Pump Flow 3rd Data Point(T/Hr)
WH(4)	35	The Head Curve for SI Pump Flow 4th Data Point (T/Hr)
WH(5)	0	The Head Curve for SI Pump Flow 5th Data Point(T/Hr)
WH(6)	0	The Head Curve for SI Pump Flow 6th Data Point (T/Hr)
WH(7)	0	The Head Curve for SI Pump Flow 7th Data Point (T/Hr)
PL(1)	0	The Head Curve for RHR Pump Pressures 1st Data Point (Bar)
PL(2)	7	The Head Curve for RHR Pump Pressures 2nd Data Point (Bar)
PL(3)	8	The Head Curve for RHR Pump Pressures 3rd Data Point (Bar)
PL(4)	8,5	The Head Curve for RHR Pump Pressures 4th Data Point (Bar)
PL(5)	8,8	The Head Curve for RHR Pump Pressures 5th Data Point (Bar)

Parameter	Value	Description
PL(6)	9	The Head Curve for RHR Pump Pressures 6th Data Point (Bar)
PL(7)	155	The Head Curve for RHR Pump Pressures 7th Data Point (Bar)
WL(1)	600	The Head Curve for RHR Pump Flow 1st Data Point (T/Hr)
WL(2)	550	The Head Curve for RHR Pump Flow 2nd Data Point (T/Hr)
WL(3)	500	The Head Curve for RHR Pump Flow 3rd Data Point (T/Hr)
WL(4)	400	The Head Curve for RHR Pump Flow 4th Data Point (T/Hr)
WL(5)	200	The Head Curve for RHR Pump Flow 5th Data Point (T/Hr)
WL(6)	30	The Head Curve for RHR Pump Flow 6th Data Point (T/Hr)
WL(7)	0	The Head Curve for RHR Pump Flow 7th Data Point (T/Hr)
PCSP	1,3	Containment Spray Initiation Pressure (Bar)
GCSP	640	Containment Spray Capacity (T/Hr)
USTC	0,01	Core Uncovery Steam Cooling Effectiveness as Fraction Of Water Cooling
Cooling		
TF0	788,9	Average Fuel Temperature at Full Power (°C)
PDSN	3,089	Containment Design Pressure (Bar)
WSV	2240	Main Steam Safety Valve Total Capacity (T/Hr)
PSV	85	Main Steam Safety Valve Opening Press (Bar)
TRB0	50	Initial Containment Temperature (°C)
PRB0	1,034	Initial Containment Pressure (Bar)
LWRB0	2,8	Initial Sump Water Level (M)
ARB	420	Sump or Containment Cross Section Area (M^2)
VRB	40000	Containment Volume (M^3)
PFCL	9,99	High Containment Pressure Set Point to Start Fan Cooler (Bar)
QCSP0	10	Emergency SI Heat Exchanger Rated Capacity (MW)
QCL0	28	Fan Cooler Capacity (MW)
TDSN	128	Containment Design Temperature (°C)
CRTM	10	Containment Heat Sink Concrete Mass (Ton)
STLM	5	Containment Heat Sink Steel Mass (Ton)
RLK0	0,1	Containment Leak Rate (%/Day) at Design Pressure
PCRT	6,895	RC Pressure for Break Flow Changed to Non-Critical (Bar)
RDSP	0,001	Rod Speed Constant, Dimensionless Number

Parameter	Value	Description
QRHR0	10	RHR Heat Exchanger Rate (MW)
TANK0	2600	RWST Initial Water Volume M^3
TKMIN	400	RWST Water Volume to Switch To Sump M^3
PRBH	1,3	High RB Press for SI Initiation (Bar)
LPZL	0,15	Simultaneous Low PRZR Level With RC Press for SI Initiation
PSGL	38	Low SG Press for SI Initiation (Bar)
PHPL	128	Simultaneous Low RC Press With PZR Level for SI Initiation (Bar)
HCOR	3,67	Fuel Length (M)
AFUT	4500	Total Core Heat Transfer Area M^2
MZRKT	3500	Total Mass of Fuel Channel (Zr) Kg
MZRST	18000	Total Mass of Fuel Cladding (Zr) Kg
MCRT	16214	Total Mass of Control Rods Kg
MVES	3800	Mass of Vessel Bottom
CNH2B	5	Concentration of H_2 in Ctmt to Start Burn (%)
FH2O	0,0533	Fraction of H_2O in Concrete
FCO2	0,1939	Fraction of CO_2 in Concrete
FDEC	0,1	Fraction of Decomposed Concrete Gas Reacts With Corium
WVNT0	10	Containment Vent Flow at 1 Psid (Kg/S)
PPMEC	2000	ACC & RWST Boron Concentration (Ppm)

5.2.4. Studied Parameters

The next parameters are the main parameters that need to be considered during the normal function of a NPP. During a transient they are essential, because the action of the safety systems depends of them.

The next parameters, PlotData on PCTran, are studied, discussed and compared with more accurate analyses results, get from 3-D neutronics (coupled code RELAP5/QUABOX/CUBBOX) and point kinetics (RELAP5/mod3.2.2) calculations of MSLB [5].

Table 5.3 shows the parameters considered for this work.

Table 5.3 – Studied Parameters.

Parameter	Units	Name
Temperature Reactor's Core average	°C	TAVG
Temperature Hot leg A	°C	THA
Temperature Hot leg B	°C	THB
Temperature Cold leg A	°C	TCA
Temperature Cold leg B	°C	TCB
Flow SG A steam	t/h	WSTA
Flow SG B steam	t/h	WSTB
Pressure Steam generator A	bar	PSGA
Pressure Steam generator B	bar	PSGB
Power SG A heat removal	MW	QMGA
Power SG B heat removal	MW	QMGB
Flow Total break entering RB (t/hr)	t/hr	WBK
High pressure safety injection system	t/h	WHPI
Press RCS	bar	P
Level SG A narrow range	%	NSGA
Level SG B narrow range	%	NSGB
Power Nuclear Flux	%	PWNT
Press Reactor building (bar)	bar	PRB

6 Analysis and Results

In this chapter analyses and results of the simulation of a main steam line break are presented. Two sizes of the main stream line break are analysed and compared, where we can see the differences between the two cases. In the end of this chapter, a comparison with more accurate results from the paper [5] is made.

6. Analysis and Results

Different scenarios were analysed for a plant operating at 100% power (600 MWe of generated load). Starting with an analysis of a small steam line break, with diameter of 4,4 inch (11,3 cm) and 100 cm^2 of area, and continuing after with 10 times bigger break analysis.

In this study, the MSLB accident starts after 100 seconds in first case and 50 seconds in the second case, of plant regular operation, with all the default conditions.

6.1. Small Steam Line Break

Small steam line break with diameter of 4,4 inch (11,3 cm) and 100 cm^2 of area is detailed analysed in this section. The obtained data of the simulation is analysed and important conclusions are obtained about the transient.

During the simulation, a series of events happen since the start of the initiating event, through the reactor trip and after that also. Table 6.1 shows in summary, these events for a 100 cm^2 main steam line break.

Table 6.1 - Sequence of events after a small main steam line break.

Time	Event
000100,5 sec	Initiating event 3 Fraction = 100,0 %
000728,0 sec	HPSI start high RB Press 1,30 bar
00728,0 sec	HPI Pump #1 Position Change: 100%
00728,0 sec	HPI Pump #2 Position Change: 100%
00728,0 sec	HPI Pump #3 Position Change: 0%
00728,0 sec	Ctmt Vent Valve #1 Position Change: 0%
00728,0 sec	RBS Pump #1 Position Change: 100%
00728,0 sec	RBS Pump #2 Position Change: 100%
00728,0 sec	Ctmt Spray Starts 1,3 bar
000728,5 sec	TDAFW Pump Position Change: 100%
000729,0 sec	All MFW Pumps trip
000729,0 sec	Condensate Pump #1 Position Change: 0%
000729,0 sec	Feed Pump #1 Position Change: 0%

Time	Event
000729,0 sec	Feed Pump #2 Position Change: 0%
000729,0 sec	MDAFW Pump #1 Position Change: 100%
000729,0 sec	MDAFW Pump #2 Position Change: 100%
000771,0 sec	Trip Low SG Level 17,0 %
000771,5 sec	Reactor Trip
000890,0 sec	MFW isolation on low 281,0 C
000890,0 sec	FWIV #1 Position Change: 0%
000890,0 sec	FWIV #2 Position Change: 0%
001118,5 sec	MSIV #0 Position Change: 0%
001254,0 sec	MSIV #1 Position Change: 0%

The initiating event number 3 (Steam Line Break Inside Containment) starts after 100,5 seconds of simulation. This rupture creates a leak of steam at high temperature inside the reactor building that increase the pressure of this.

Figure 6.1 shows the pressure evolution inside the reactor building.

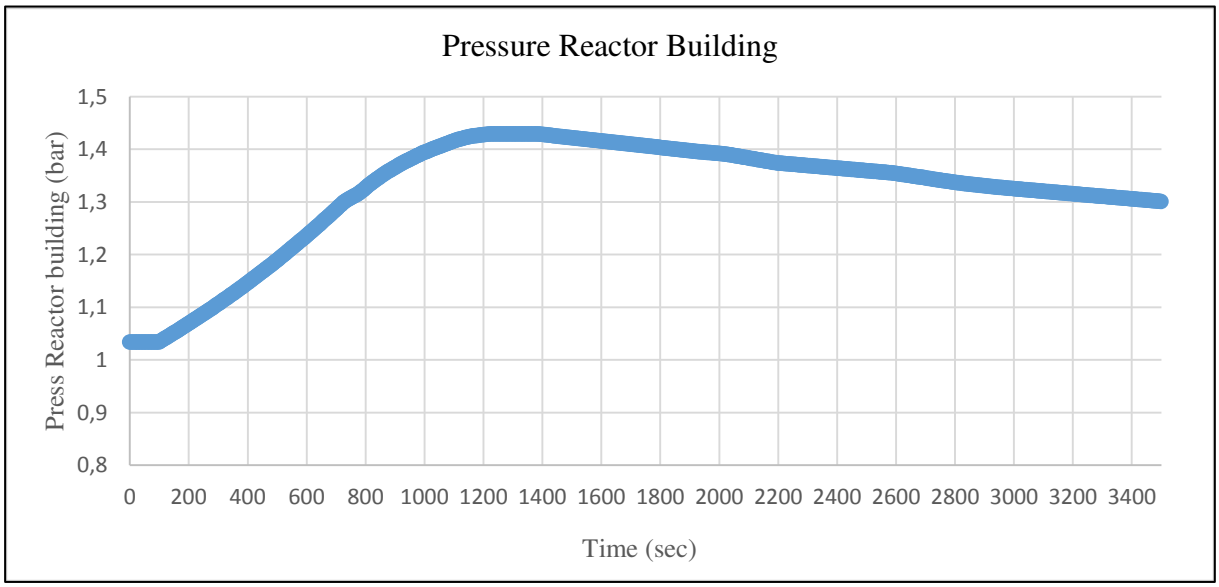

Figure 6.1 - Pressure Reactor Building.

When the pressure reaches 1,3 bar in the reactor building (628 seconds after the initiating event), the Safety Feature Actuation System (SFAS) detects overpressure and send signal to activate one of the Emergency Core Cooling Systems (ECCS). This system consists of redundant

trains of cooling systems, for core heat removal during emergency. ECCS are generally composed of High Pressure Safety Injection (HPSI) System, Accumulators (ACC) and the Low Pressure Safety Injection (LPSI) System.

The HPSI System is activated 628 seconds after the event, in the next figure the increasing flow of water is visible. This redundant trains of centrifugal pumps are triggered if low reactor pressure and/or low pressurizer level signal, or high containment pressure signal is detected, like in this case [21].

Figure 6.2 shows the flow of water injected by the HPSI System.

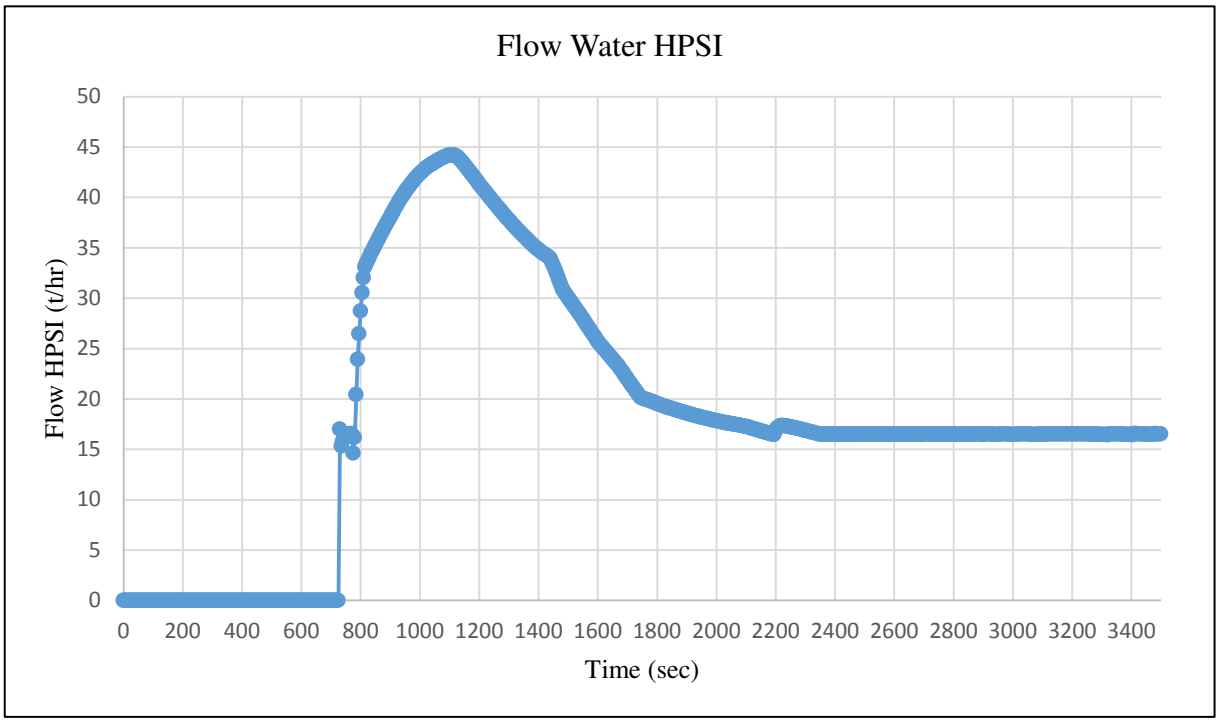

Figure 6.2 - Flow Water High Pressure Safety Injection (HPSI) System.

The containment ventilation valve is closed, at the same time, because of this unusual high pressure in the reactor building. RB is isolated to prevent the release of radioactive material to the environment. Containment spray starts also, which is a system consisted of a series of pumps and sprays that spray coolant into the primary containment structure, to condense the steam liberated by the leak into liquid and low the pressure inside.

Main emergency feedwater pumps start working 629 seconds after the event, increasing the flow on HPSI, at the same time the trip of the regular feedwater pumps is registered.

The water level in the steam generators is controlled by the feedwater system and because it is turned off, the level of water in the SGs will drop quickly as we can see in the next figures.

Figure 6.3 shows the water level in the SGs during the transient.

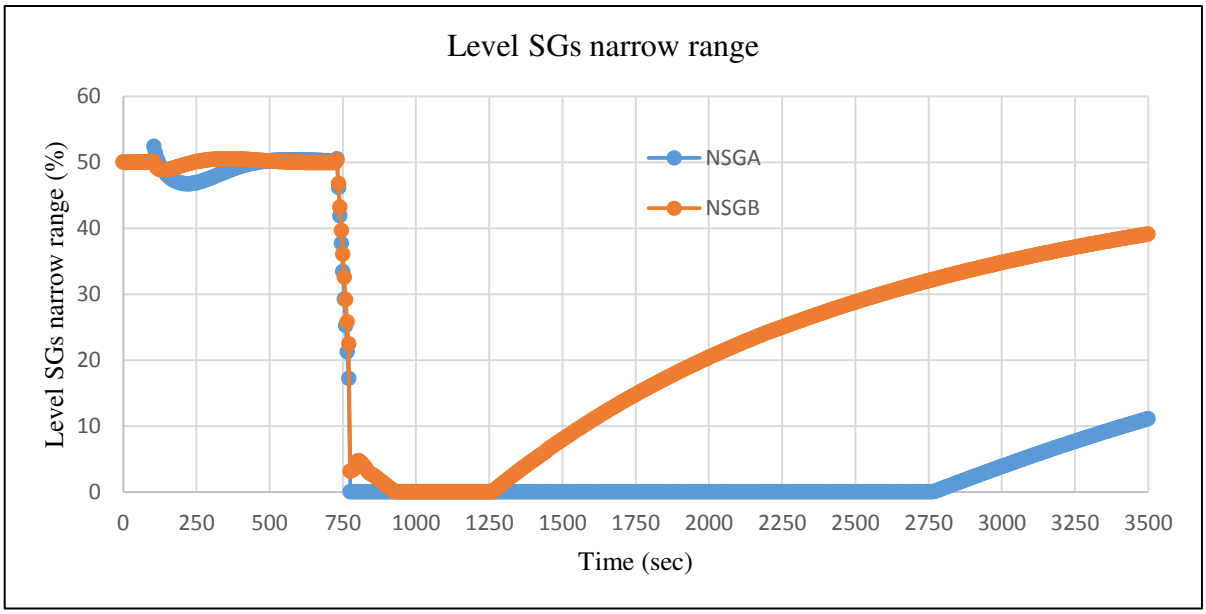

Figure 6.3 - Level SGs narrow range (water level).

Figure 6.4 shows the water level in the SGs more details.

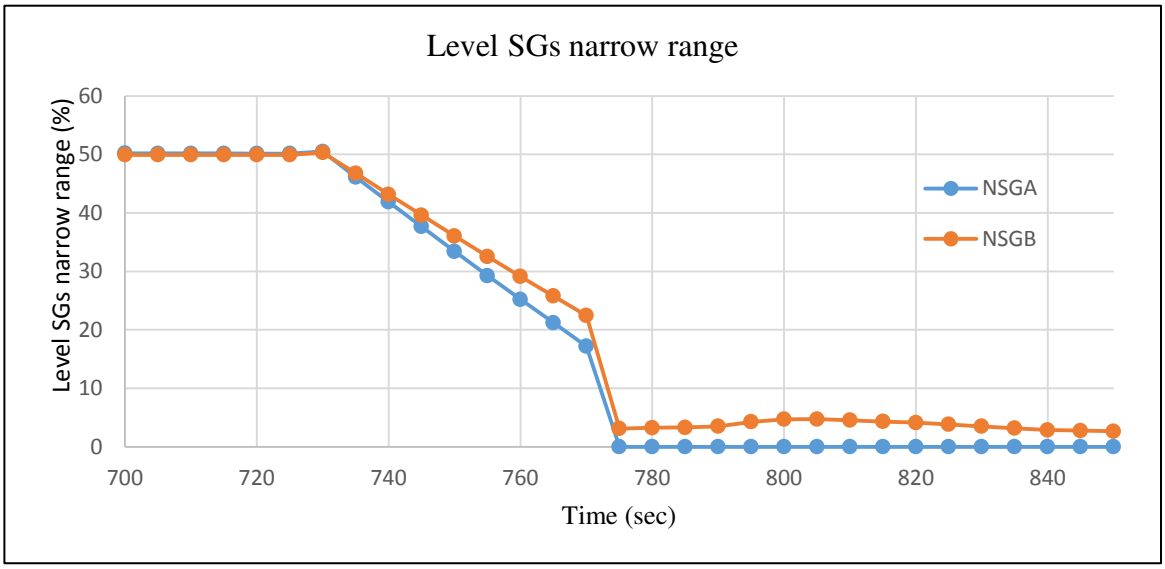

Figure 6.4 - Level SGs narrow range (detailed view).

The reactor trip is initiated by a Low-Low SG Level (17,0 % Narrow Range) detection in the narrow range sensors, after 671 seconds (approx. 11 min.) of the initiating event, followed by a sequence of events to mitigate this incident.

During the reactor trip all control rods are dropped by gravity into the core to suppress the chain reaction in seconds.

Figure 6.5 shows the Cold leg temperatures in the SGs.

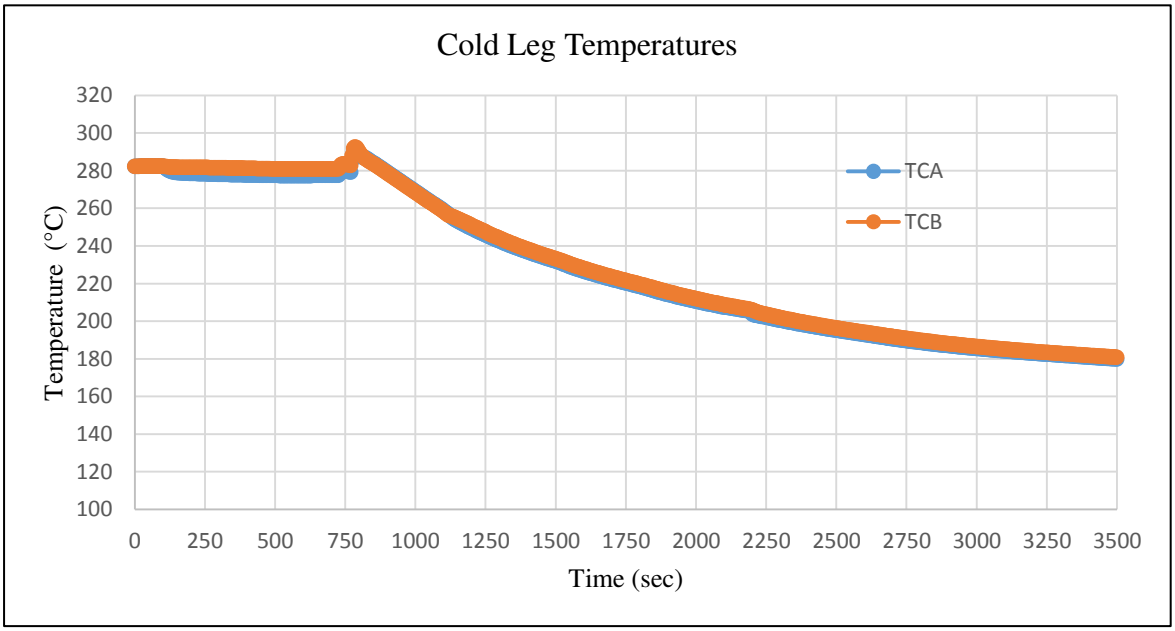

Figure 6.5 - Cold leg temperatures.

The temperatures in the primary cooling system stay relatively stable since the beginning of the simulation until the reactor trip, as we can see in the figures 6.5, 6.6 and 6.7 (cold leg, hot leg and average temperatures, respectively). This happens because the small leak doesn't have big influence on all the system.

When the chain reaction is suppressed, 11 minutes after the event, the temperatures start falling rapidly, as expected.

Figure 6.6 shows the Hot leg temperatures in the SGs.

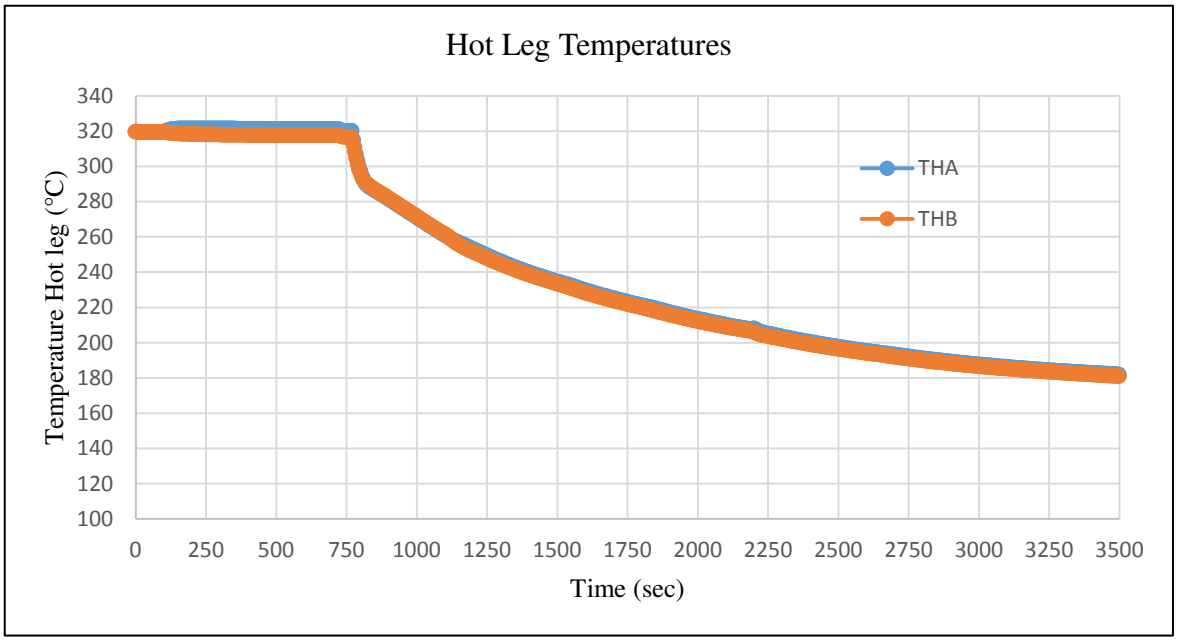

Figure 6.6 - Hot Leg Temperatures.

Figure 6.7 shows the reactor cooling system average temperature.

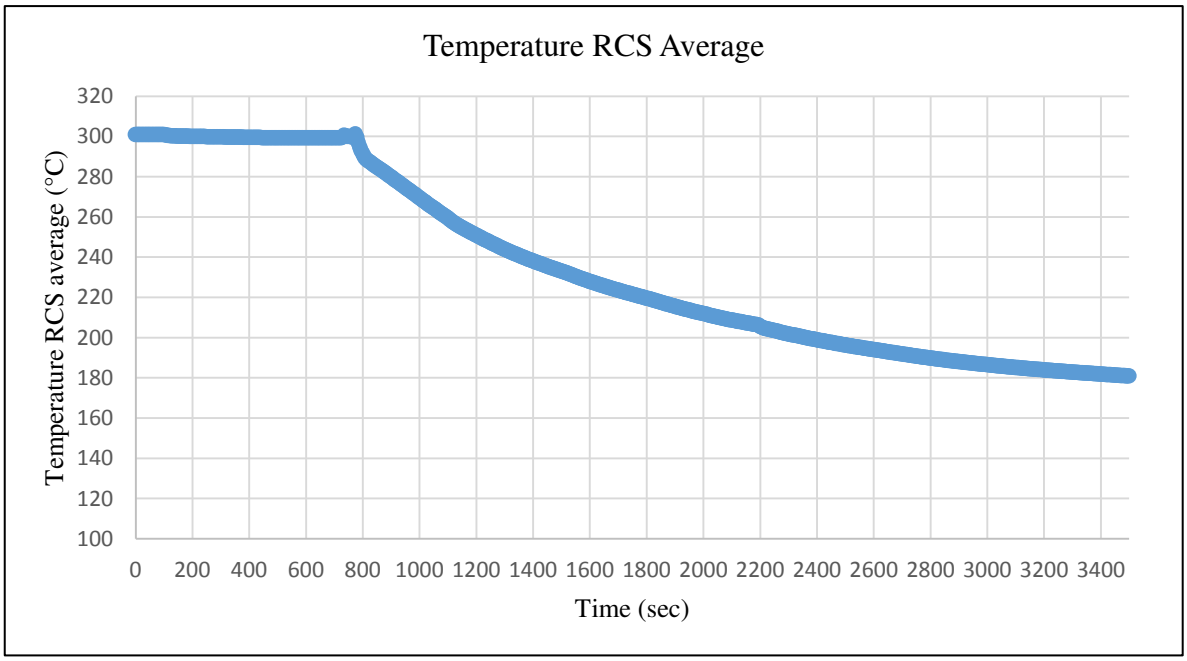

Figure 6.7 – Temperature Reactor Coolant System (RCS) average.

The reactor trip causes a rapid decrease of the Reactor Coolant System (RCS) average temperature. Isolation of both SGs is initiated when it reaches 281ºC (790 seconds after the

event), closing the Main Feed Water Isolation Valves (FWIV). The Main Steam Isolation Valves (MSIVs) closes around 4 minutes later.

Figure 6.8 shows the flow of steam leaked.

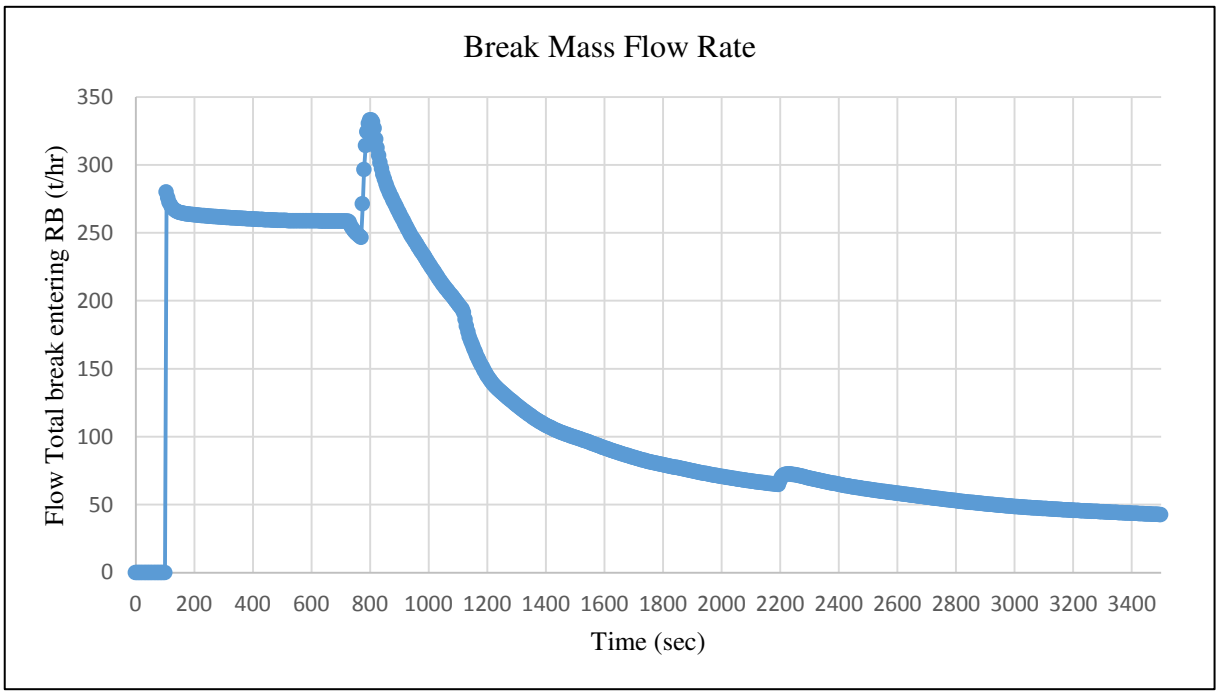

Figure 6.8 - Break Mass Flow Rate.

Because of the small break, mass of steam leaked is relatively small since the beginning (Figure 6.8). The reactor trip, 671 seconds after the initiating event, leads to a decrease in core temperature that creates a rapid decrease in the leaked steam flow. We can also see that when the MSIVs close, this flow decreases even faster.

Another important aspect to analyse is the evolution of the pressure in the main parts. When the fault occurs, like is visible in the figure 6.10, a very small drop on the primary pressure happens. This almost imperceptible drop is caused by the loss of steam on the secondary side and the increase in heat transfers between the two loops. In the next figure, the increase of heat removed in the steam generator located near the break is visible, like was expected.

Figure 6.9 shows the heat removed in each SG.

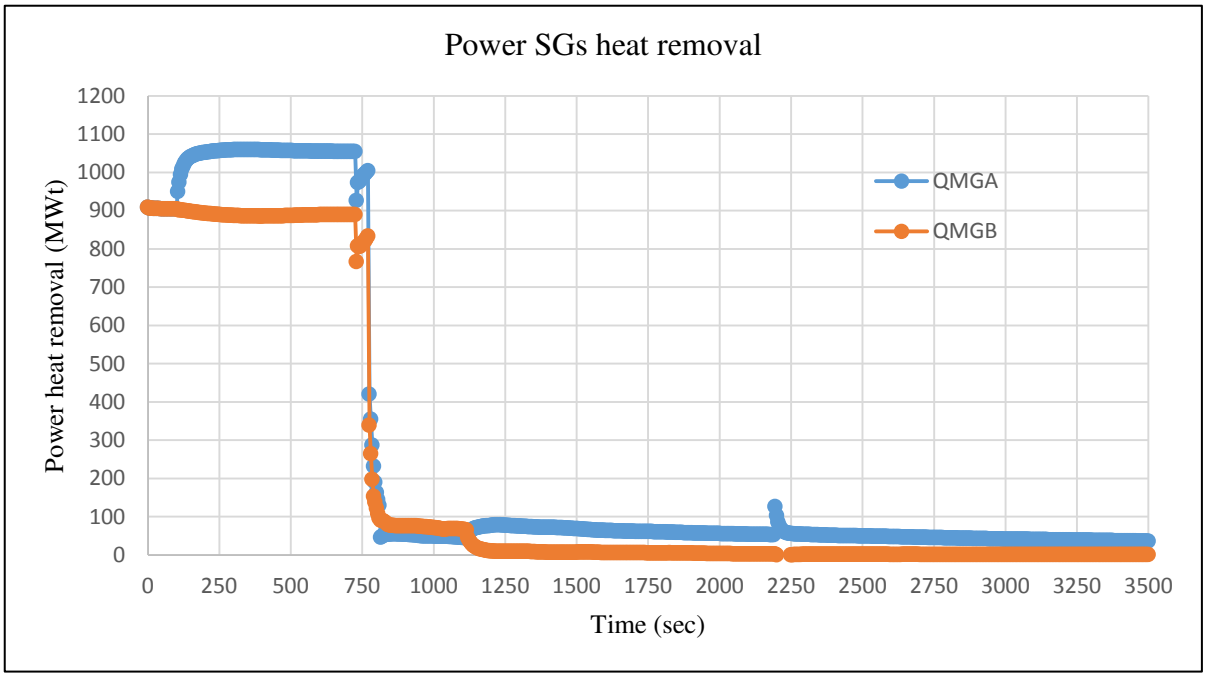

Figure 6.9 - Power SGs heat removal.

Although the small decrease of pressure, the pressurizer easily stabilizes the pressure in the default values, until the reactor trip.

Figure 6.10 shows the evolution of the pressure in the reactor core.

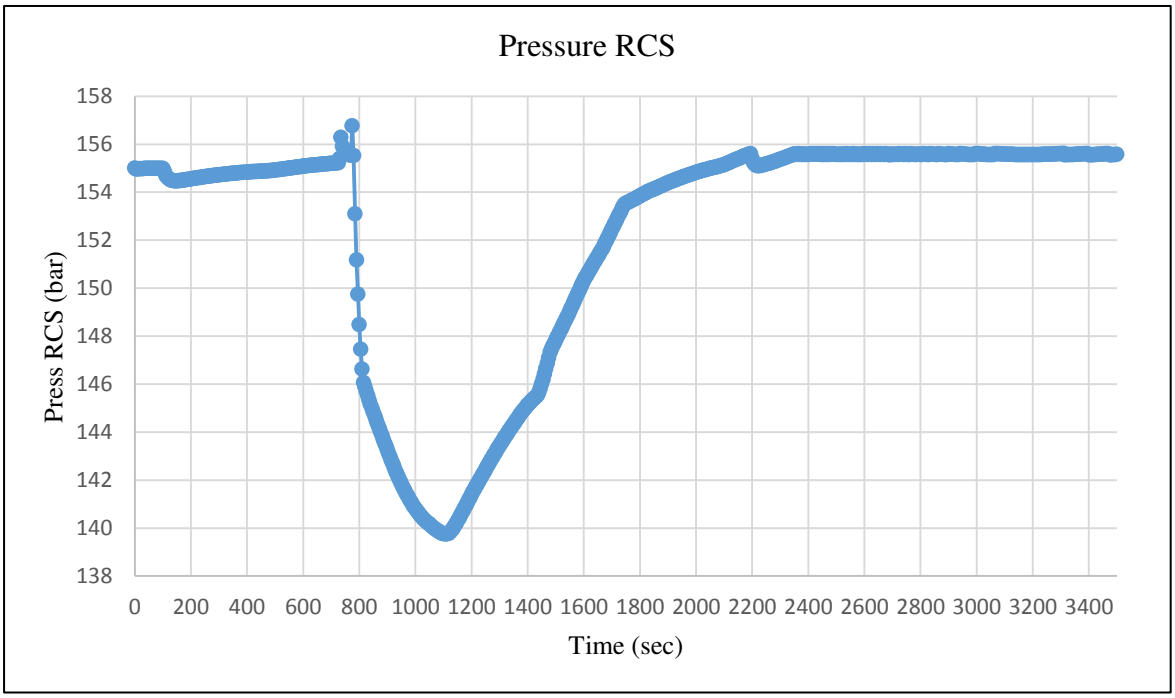

Figure 6.10 - Pressure RCS.

After the reactor trip, the pressure decreases rapidly and is still decreasing until the isolation of the main feedwater and the main steam, approximately at 1120 seconds of simulation. After this, the pressure recovers and after 1000 seconds stabilizes at the default value around 155 bar.

Figure 6.11 shows the pressure in the SGs.

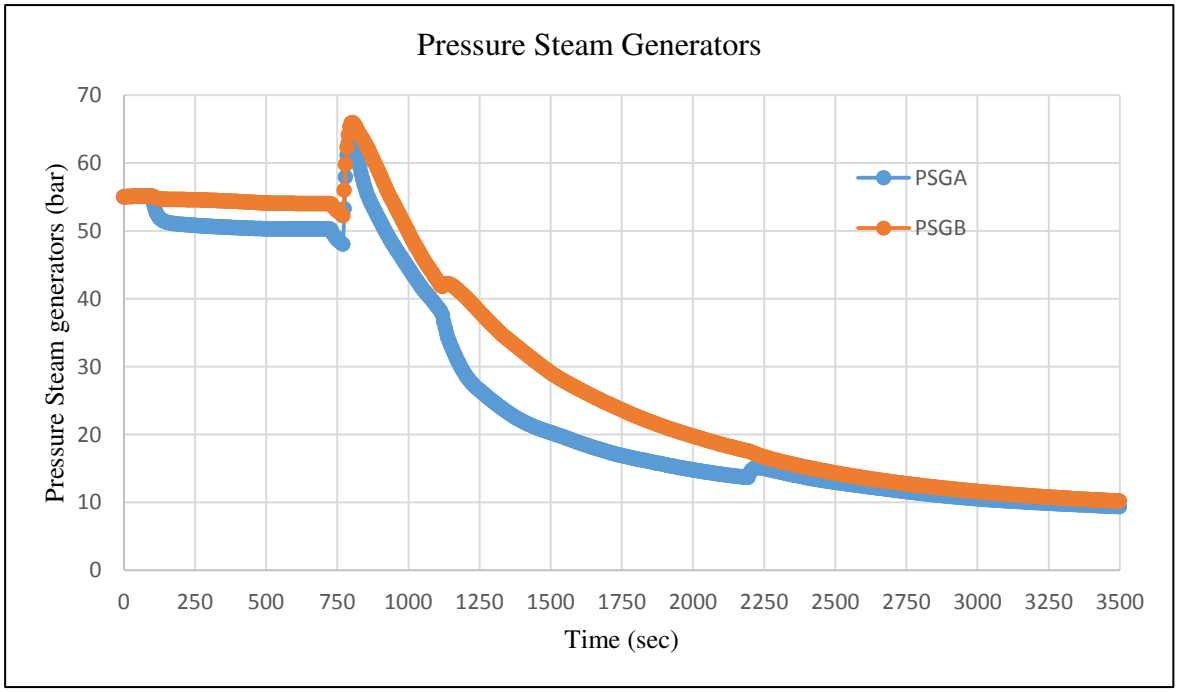

Figure 6.11 - Pressure Steam Generators.

When the event starts, the pressure in the steam generator A (Figure 6.11) decreases instantly, since the leak is near the SG A. Depressurization is even faster in the SG A, after reactors trip.

After the data analysis and in summary, when a small break like that happens, the variations in parameters like temperatures, steam flow in the SGs and pressures are not so expressive. The reactor trip takes a relatively long time to happen, about 11 minutes and is caused by overpressure in the reactor building. This unexpected but understandable trip reason happens, because of the small steam leak. Since the leak is so small the overcooling of the core doesn't succeed like is expected in the majority of MSLBs and the protection system takes more time to identify the fault and to actuate.

6.2. Large Steam Line Break

Now a 10x larger steam line break with 14 inch (35,7 cm) of diameter and 1000 cm^2 of area is studied, the obtained data is analysed again and comparisons are made with the small break case.

The table 6.2 shows the events that happened since the initiating event till the reactor trip and the isolation of the fault.

Table 6.2 - Sequence of events after a large main steam line break.

Time	Event
000050,5 sec	Initiating event 3 Fraction = 1000,0 %
000050,5 sec	HPI Pump #3 Position Change: 100%
000055,5 sec	Trip High Flux 118,0 %
000056,0 sec	Reactor Trip
000056,5 sec	HPI Pump #3 Position Change: 0%
000071,5 sec	MFW isolation on low 281,0 C
000071,5 sec	FWIV #1 Position Change: 0%
000071,5 sec	FWIV #2 Position Change: 0%
000076,0 sec	HPI Pump #3 Position Change: 100%
000081,5 sec	HPSI start low SG Press 38,00 bar
000081,5 sec	HPI Pump #1 Position Change: 100%
000081,5 sec	HPI Pump #2 Position Change: 100%
000081,5 sec	HPI Pump #3 Position Change: 0%
000081,5 sec	Ctmt Vent Valve #1 Position Change: 0%
000081,5 sec	MSIV #0 Position Change: 0%
000082,0 sec	TDAFW Pump Position Change: 100%
000082,5 sec	All MFW Pumps trip
000082,5 sec	Condensate Pump #1 Position Change: 0%
000082,5 sec	Feed Pump #1 Position Change: 0%
000082,5 sec	Feed Pump #2 Position Change: 0%
000082,5 sec	MDAFW Pump #1 Position Change: 100%
000082,5 sec	MDAFW Pump #2 Position Change: 100%
000177,0 sec	MSIV #1 Position Change: 0%
000178,5 sec	RBS Pump #1 Position Change: 100%

Time	Event
000178,5 sec	RBS Pump #2 Position Change: 100%
000178,5 sec	Ctmt Spray Starts 1,3 bar

The massive break causes a large leak of steam. The events in this situation are dramatically faster when they are compared with the events analysed before.

The large rupture near the SG A (initiating event 3, at 50 seconds), causes fast increase of steam flow to this SG, steam that is leaking to the reactor building by the break (Figures 6.12 and 6.13). Steam flow redirected to the SG A, causes a quickly drop to 0 in the SG B.

Figure 6.12 shows the flow of steam leaked to the RB.

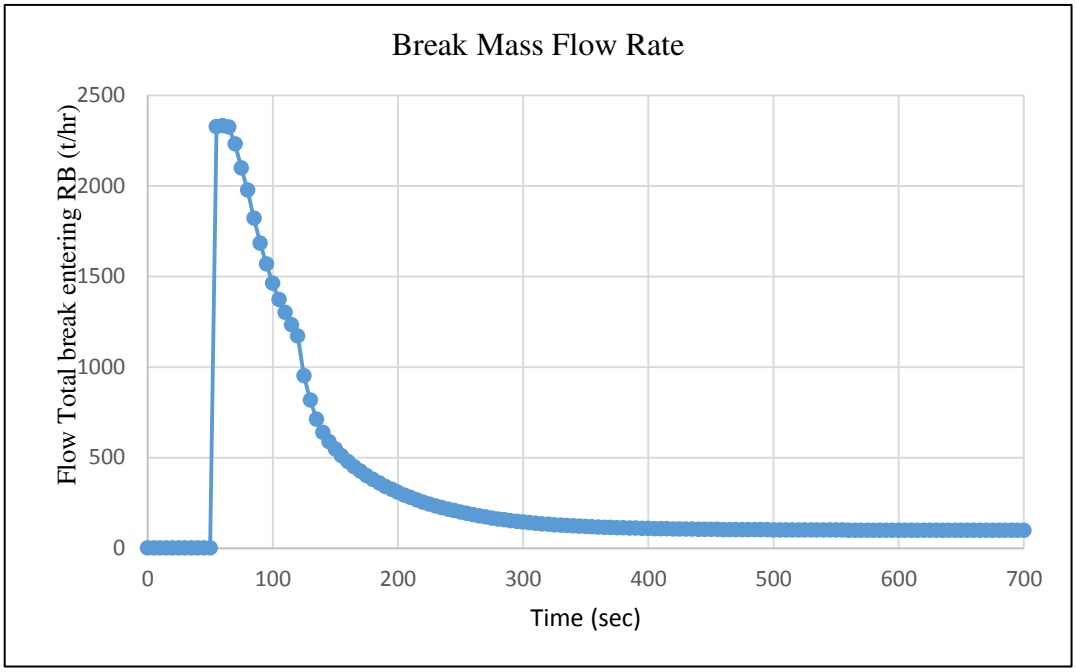

Figure 6.12 - Break Mass Flow Rate.

Figure 6.13 shows the flow of steam in each SG during the transient.

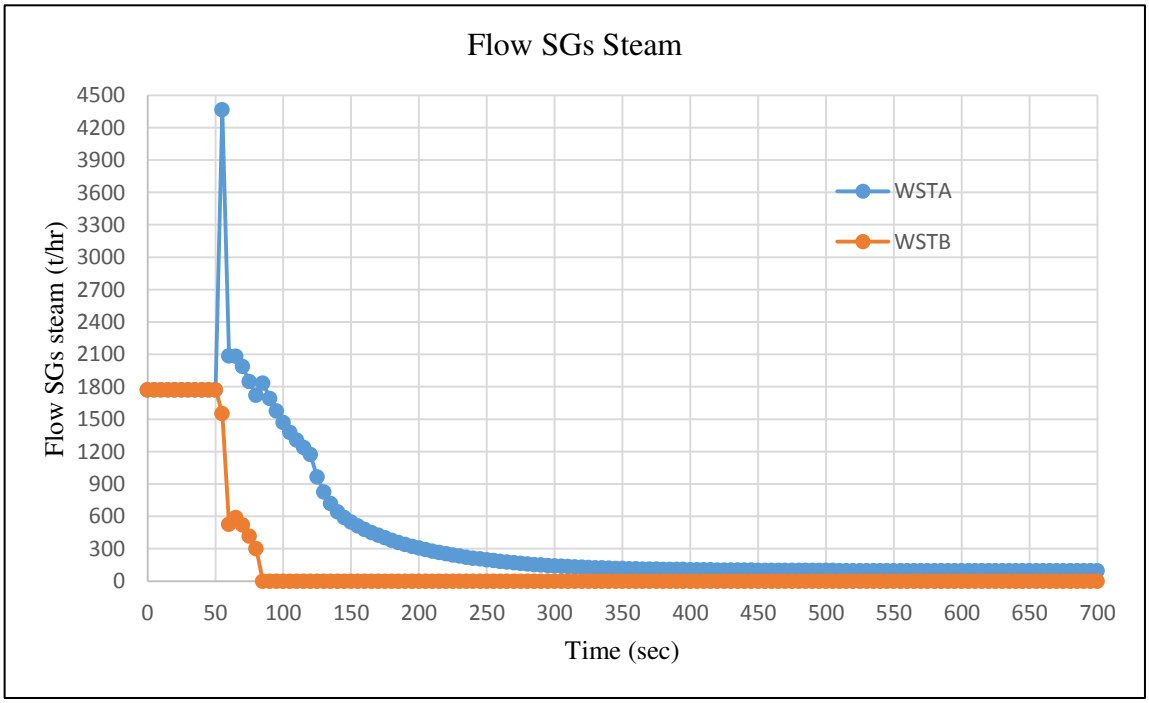

Figure 6.13 - Flow SGs Steam.

The rapid increase in heat transfers between the primary and secondary loop, causes the overcool of the primary system and fast decrease in RCS average temperature (Figure 6.14) and pressure (Figure 6.15).

Figure 6.14 shows the average temperature in RCS.

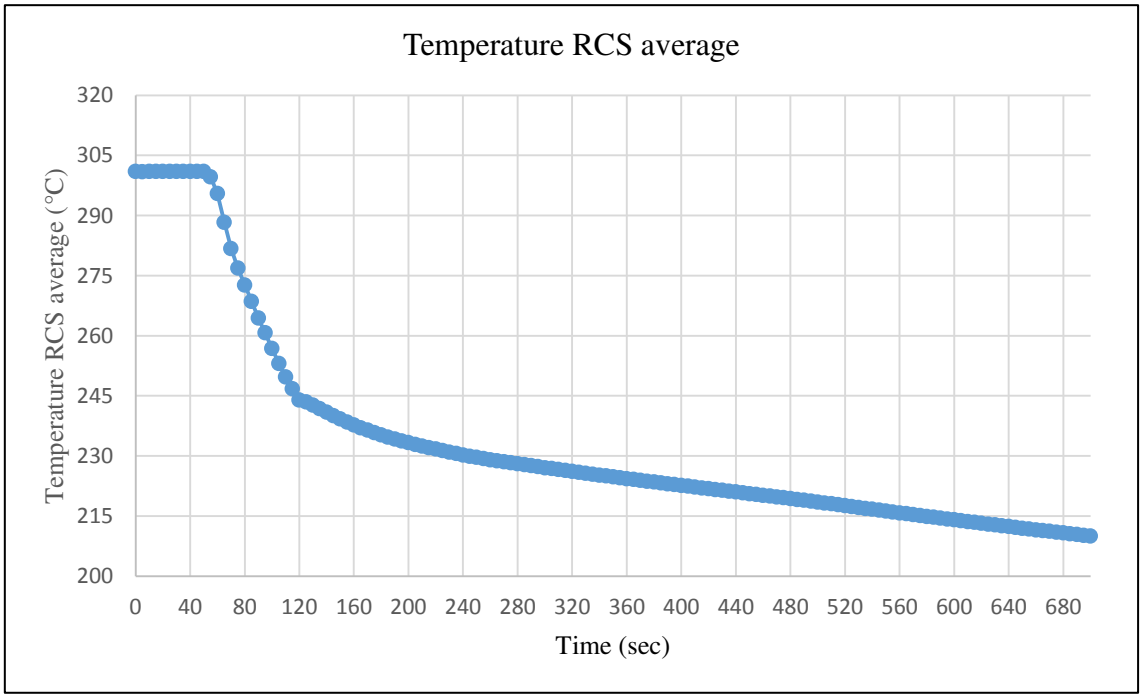

Figure 6.14 - Temperature Reactor Coolant System (RCS) average.

Figure 6.15 shows the pressure in the RCS during the transient.

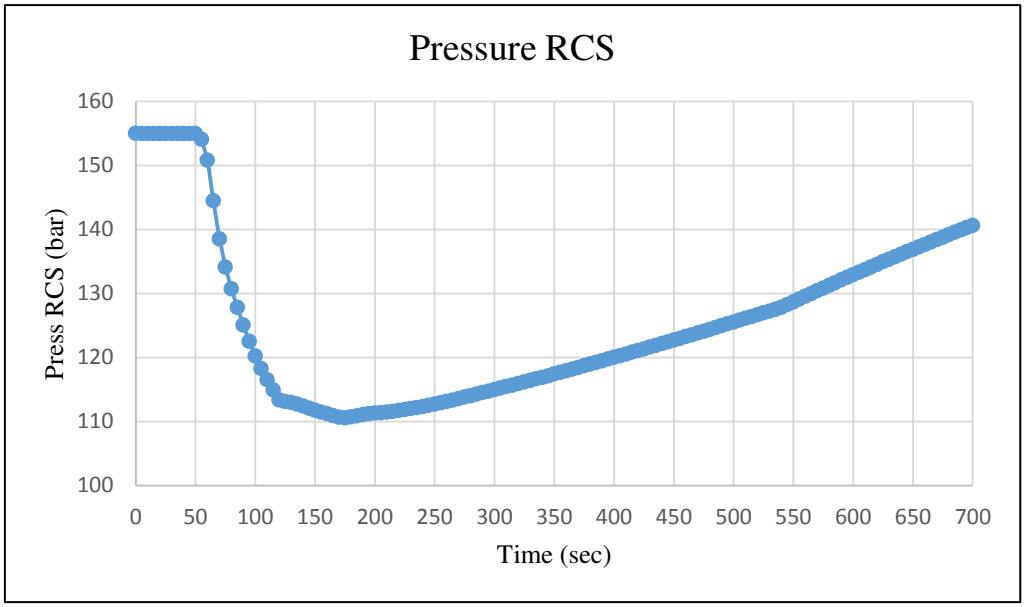

Figure 6.15 - Pressure RCS.

The overcooling of primary coolant system has impact on reactivity behaviour, because of the fuel negative moderator temperature coefficient. So when the initiating event starts, the neutron flux (Figure 6.16) increases notably as expected.

Figure 6.16 shows the neutron flux in the core.

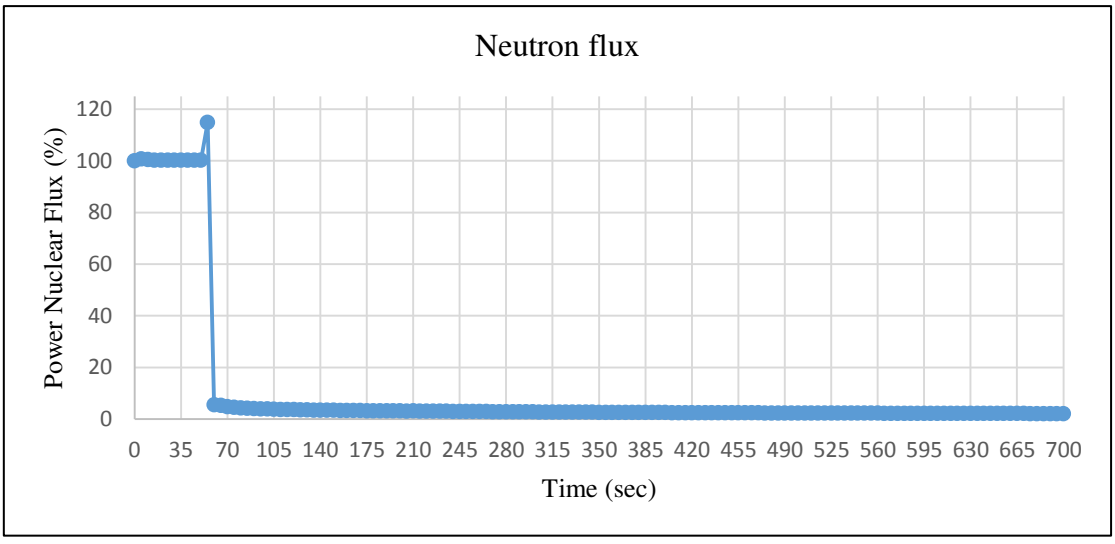

Figure 6.16 - Neutron flux.

The instantaneous increase in the reactivity causes the reactor trip, just 6 seconds after the initiating event. The trip is triggered by the safety systems when the neutron power reaches 118% of 1800 MWt, at the same moment the reactivity falls almost to 0.

After the reactor trip, the temperature falls even faster and just 15.5 seconds after the trip, the Reactor Coolant System (RCS) average temperature (Figure 6.14) falls down to 281ºC and the main feed water isolation occurs, by closing of the Main Feed Water Isolation Valves (FWIV). Emergency feedwater pumps also start working with a delay of 10 seconds.

Figure 6.17 shows the pressure in the SGs.

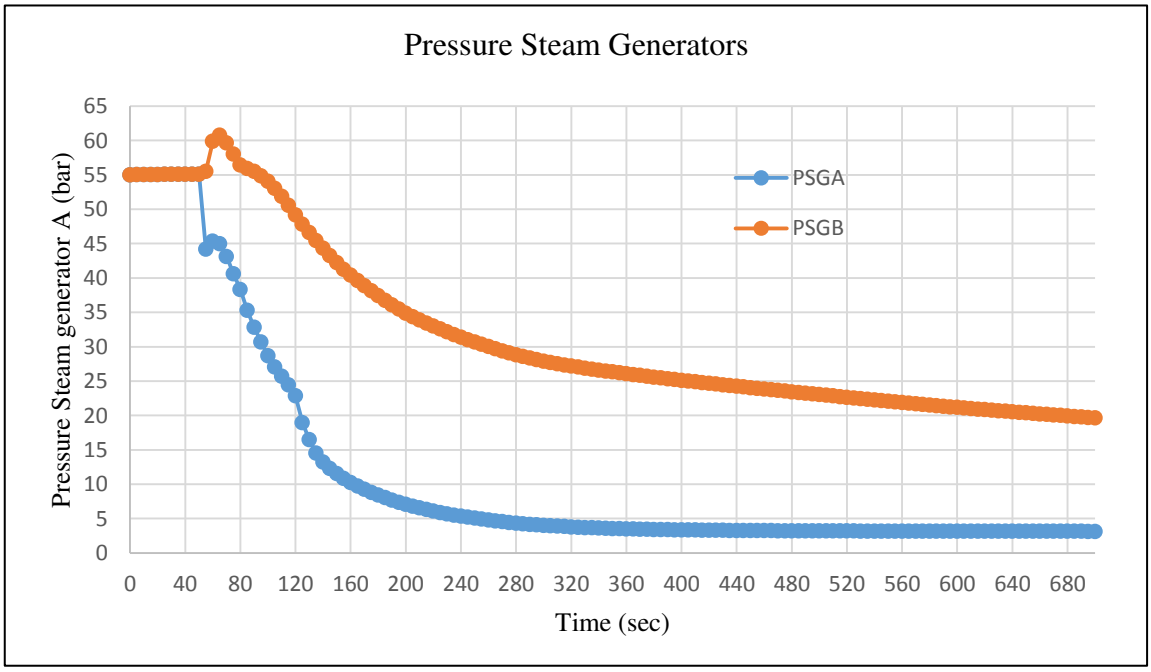

Figure 6.17 - Pressure Steam Generators.

The SG isolation and High Pressure Safety Injection (HPSI) were initiated by a low steam line pressure signal 31 seconds after the event, when the pressure in the SG A falls to 38 bars. At the same time also the containment ventilation valves close, preventing the leak of radioactive material to the environment.

Another event to be considered is the pressure in the containment that increases and 128 seconds after the initiating event the containment spray starts injecting coolant to stabilize the pressure inside the containment.

After the data analysis and in summary, when a large break occurs with a large flow of steam leaking, the variations in parameters like temperatures, steam flow in the SGs, pressures and in the end reactivity, are very expressive and almost instantaneous. So, in opposition to the accident studied before, the reactor trip takes just few seconds to happen (6 seconds), and is triggered by high neutron flux, as expected after a MSLB.

After the reactor trip, the systems react in the similar way like the first simulation. The feed water and steam isolation occurs, the emergency cooling systems enters in action to remove the decay heat and the coolant spray to decrease the pressure inside the containment.

Because of these really fast events, the protection systems actuate really fast also.

6.3. Comparison of Results

A comparison between the results obtained with PCTran during the simulation of a large MSLB (1000 cm^2), with a more detailed simulation, obtained from 3-D neutronics (coupled code RELAP5/QUABOX/CUBBOX) and point kinetics (RELAP5/mod3.2.2) is performed.

The data for the comparison were obtained from the paper [5]. The paper presents the comparison between the 3-D neutronics (coupled code RELAP5/QUABOX/CUBBOX) and point kinetics (RELAP5/mod3.2.2) calculations of MSLB accident for two loop NPP with pressurized water reactor with 1994 MWt [5]. Another thing to have in mind during the comparison is that the transient starts with 50 seconds of delay, in the case of our results, and 0 seconds in the compared results [5].

Figure 6.18 shows the comparison between the simulation and the paper [5], related to the break mass flow rate.

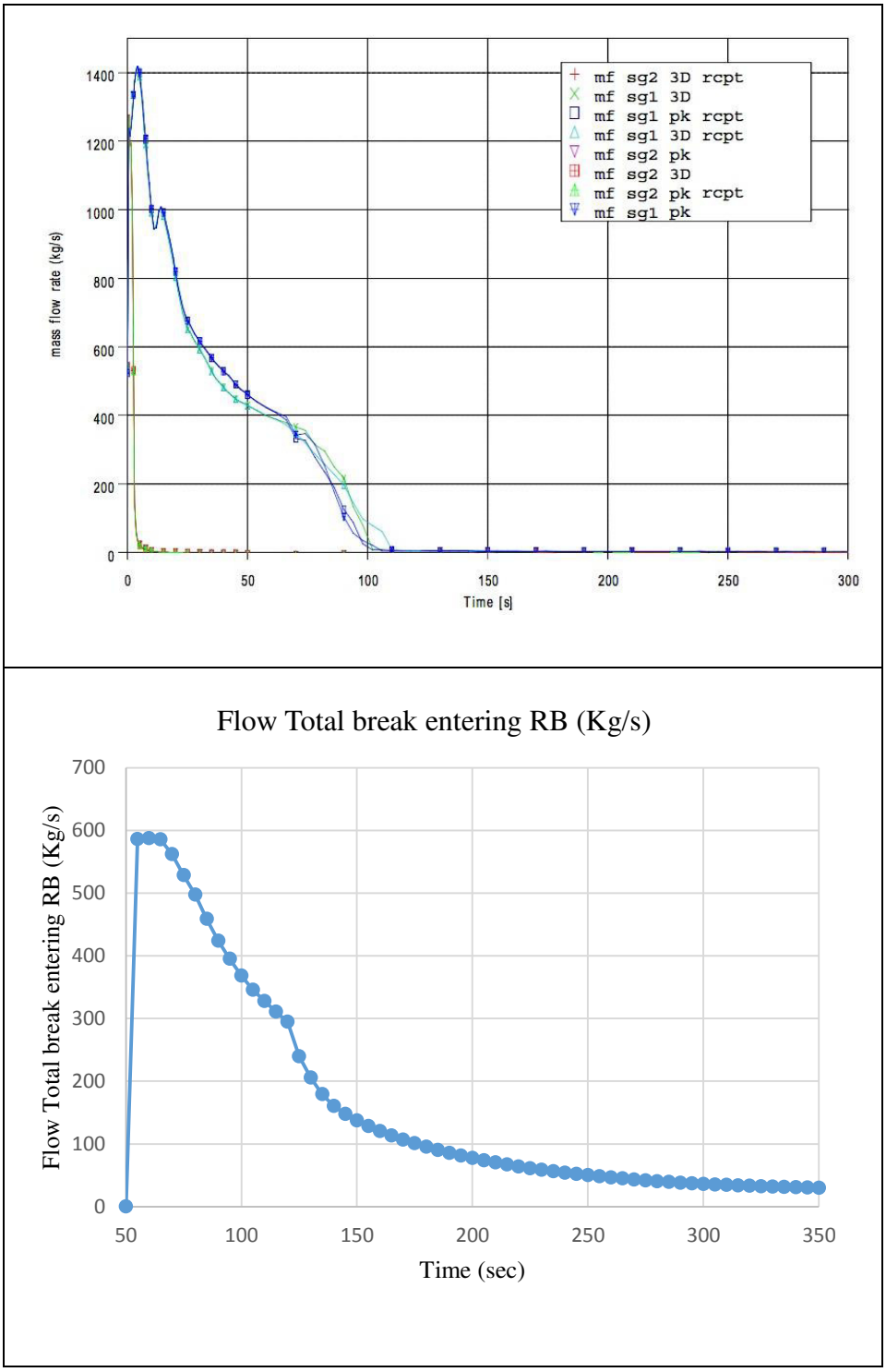

Figure 6.18 – Comparison Break mass flow rate [5].

In the first plot, the data obtained from 3-D neutronics and point kinetics simulation from the paper [5], the leak of steam in SG 1 indicates that the break is near this SG. In PCTran simulator is presented all volume of leak steam in just one line without differences between SGs. The curve presents a similar shape in time as expected only the flow is different, probably because the break studied in this paper [5] is larger.

Figure 6.19 shows comparison between the simulation and the paper [5], related to the Cold leg temperature.

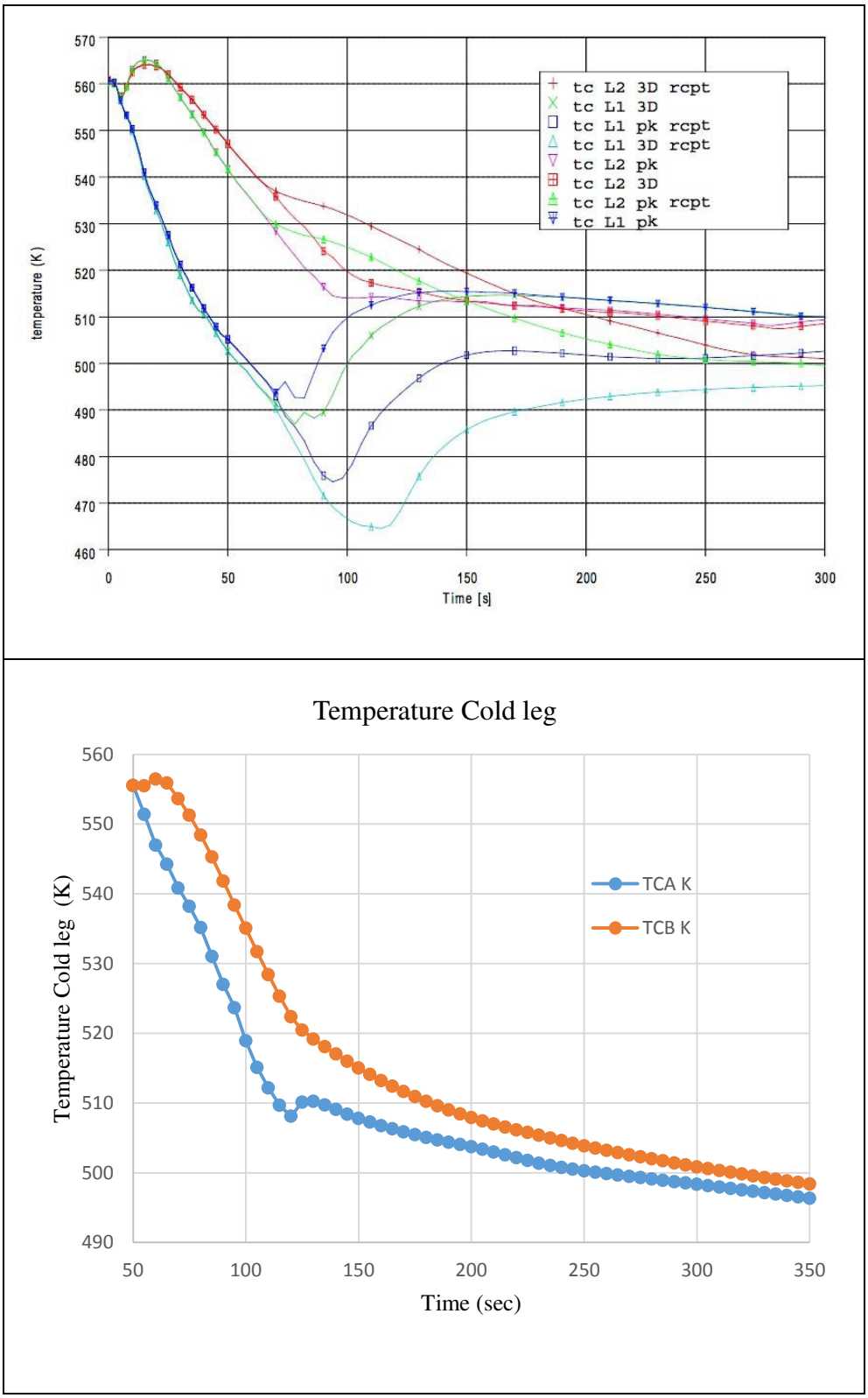

Figure 6.19 – Comparison Cold leg temperatures [5].

Temperatures, Cold leg temperatures (Figure 6.19) and Hot leg (Figure 6.20), also have similar behaviour and values between PCTran and the another simulation methods used in the paper. The temperature values decrease really fast and stabilise almost at the same time around 500K in both plots. In both temperature analysis (Cold and Hot leg), the results are almost the same in both simulations and with the different methods in the paper [5].

Figure 6.20 shows comparison between the simulation and the paper [5], related to the Hot leg temperature.

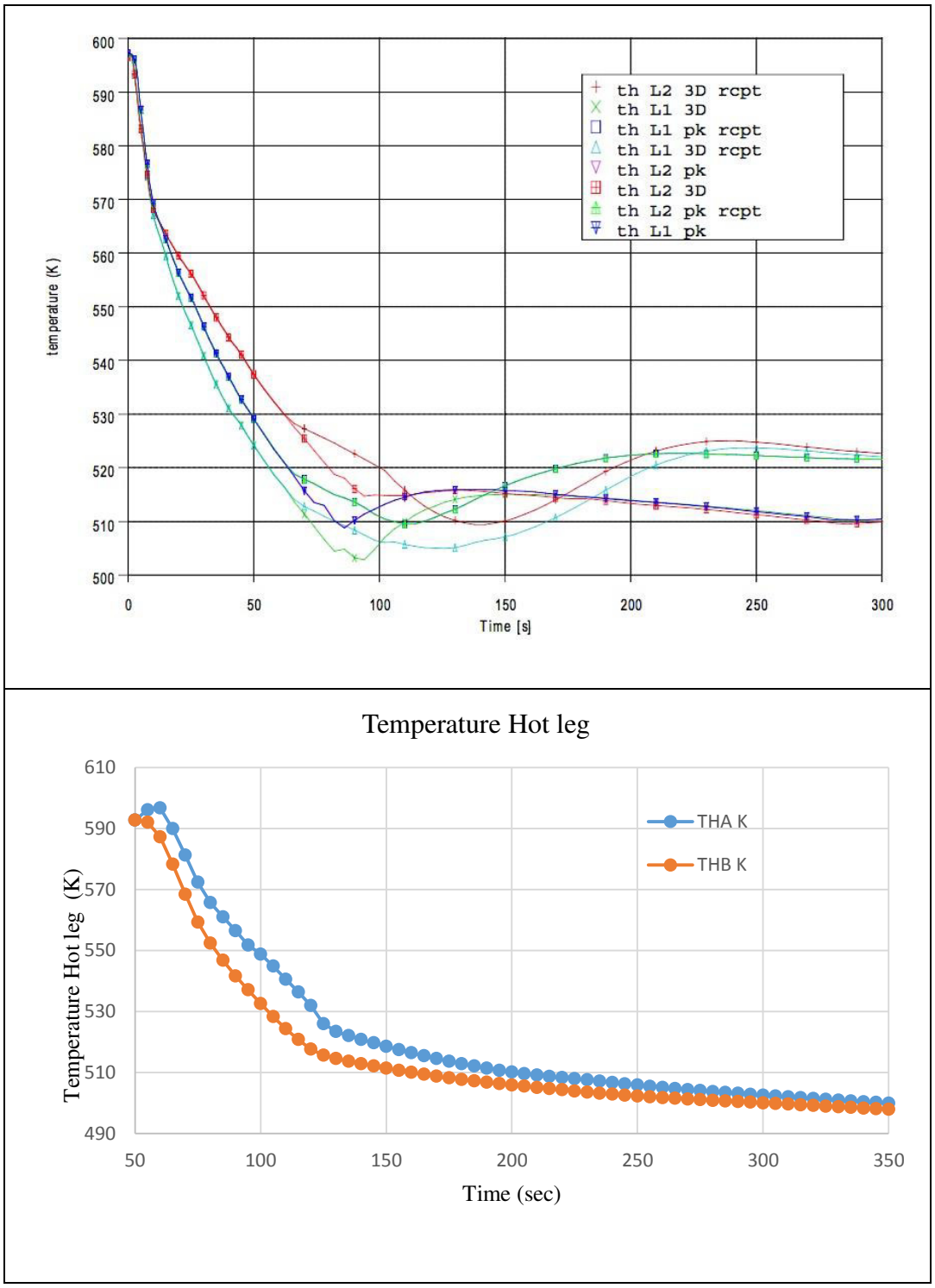

Figure 6.20 – Comparison Hot leg temperatures [5].

The pressure also presents very similar results between the two simulations, only a small difference is noted in the minimum pressure after the reactor trip, but the waves have a really similar shape and behaviour. A faster decrease is noted before the reactor trip and after in both cases the pressure starts to recover to similar values.

Figure 6.21 shows comparison between the simulation and the paper [5], related to pressure in the RCS.

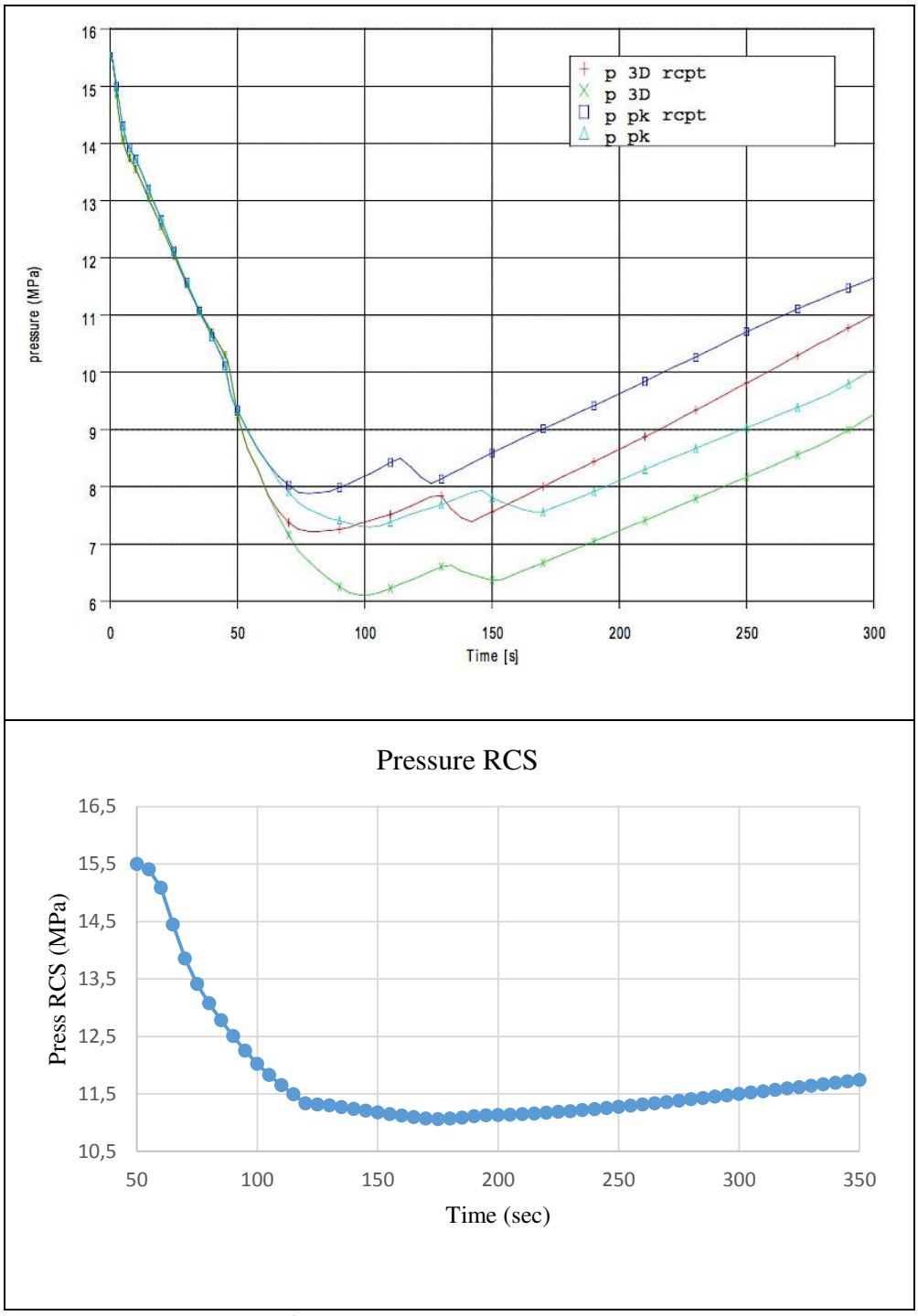

Figure 6.21 – Comparison Pressurizer pressure [5].

The small noticed differences in all the parameters analysed before, may come from the fact that in the models that are compared, are similar but not identical regarding the nominal plant power [5].

7 Conclusions

The conclusions of this thesis are discussed.

7. Conclusions

The main steam line break initiating event and the scenarios of the progress of the consequent events are studied using the simplified nuclear power plant simulator PCTran. Smaller and larger main steam line breaks are simulated and compared via a number of related parameters.

The analysis of both scenarios showed that the NPP safety systems can put the plant in a safe state after a main steam line break initiating event.

During the simulation of the 100 cm^2 (diameter of 4,4 inch) break, we can see that this loss of steam does not affect too much the main parameters of the plant operation like temperatures (Cold and Hot Leg), pressures and water levels. As a consequence of this, the reactor trip takes a relatively long time to be initiated, about 11 minutes after the initiating event and is caused by overpressure in the containment. After analysing the transient, it looks to be sufficiently moderate and slow that the operators are able to identify and isolate the ruptured steam line fast enough and can be able to perform other operations to mitigate the consequences of the main steam line break event.

During the simulation of 1000 cm^2 (diameter of 14 inch) break, a larger loss of steam occurs and the very expressive and instantaneous variations in parameters like pressures, temperatures (Cold and Hot Leg), steam flow in the SGs are observed and also the reactivity is largely affected. So, and contrarily to the smaller break, the reactor trip is initiated in 6 seconds. The reactor trip is caused by high neutron flux, as expected in these scenarios.

After these analyses we can see that the reactor system parameters are in the expected ranges. The main conclusion after these two simulations is that the safety systems are effective for achieving an automatic plant safety state, as expected, and all the emergency core cooling systems that remove the decay heat after the shutdown went into action.

In addition, the results of the analysis when they are compared with similar simulations performed with more detailed computer codes show that simplified simulator can be effectively used for education purposes. This is confirmed by comparison of the general shapes of the main parameters, which change through the time, and are similar comparing the results of simplified simulator and the results of the detailed computer code, which is used for the safety analysis.

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Appendix A

Simulation of a Small Main Steam Line Break

For the simulation of a main steam line break with diameter of 4,4 inch (11,33 cm) and 100 cm^2 of area, the software PCTran intended for two loop PWR was used. The simulation was conducted by using all the default parameters for this kind of reactor, with 100% of output power (600 MWe).

Figure A.1 shows PCTran 6.0.1 Mimic, with initial conditions.

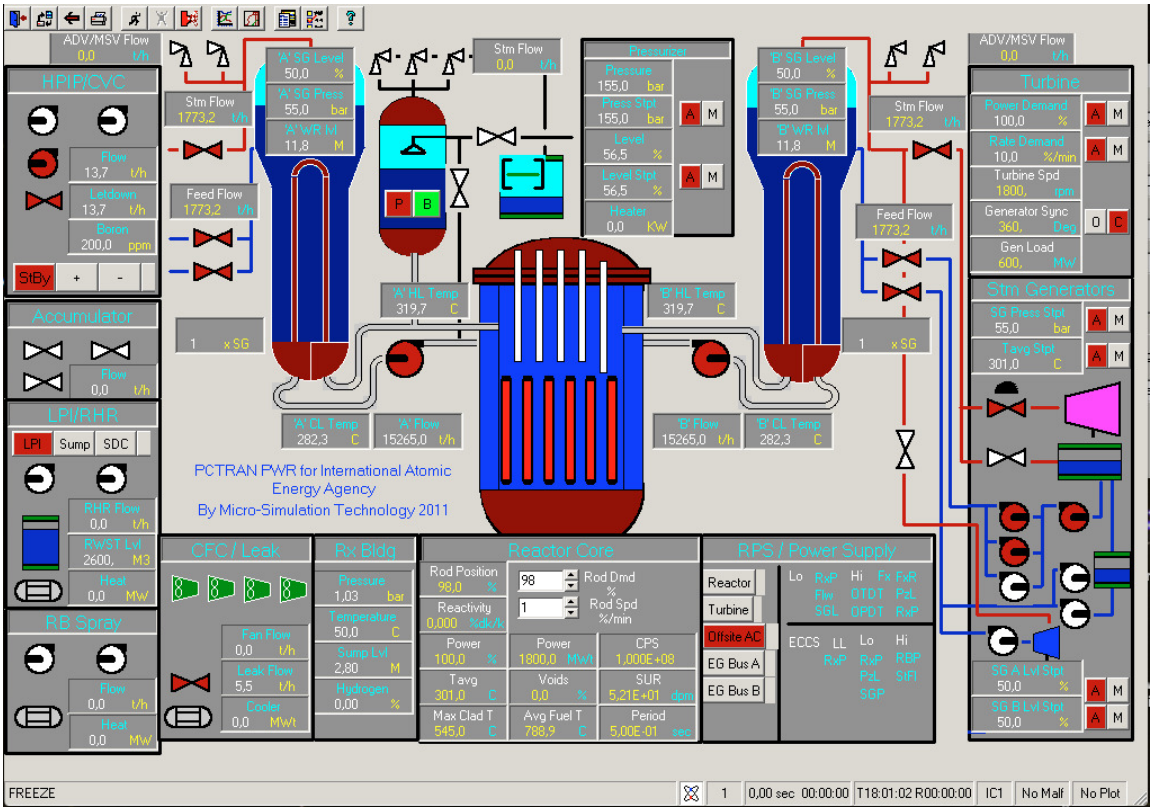

Figure A.1 - PCTran 6.0.1 display, with initial conditions.

The initiating event number 3 (Steam Line Break Inside Containment) was selected, with a delay of 100 seconds, like it is visible in the next figure.

Figure A.2 shows the window with the initiating event selection.

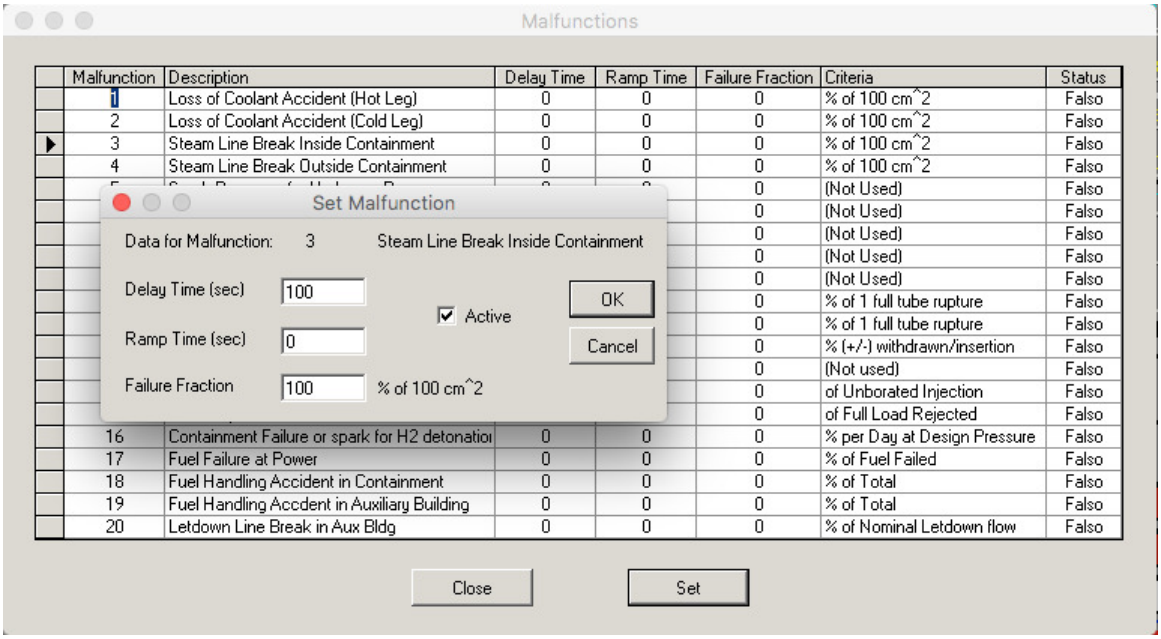

Figure A.2 – Initiating event selection.

After 3500 seconds of simulation, between all the obtained data, the next information was studied in this work.

Table A.1 shows the data analysed during the 100 cm^2 MSLB.

Table A.1 – Used data during the small MSLB.

Parameter	Units	Name
Temperature Reactor's Core average	°C	TAVG
Temperature Hot leg A	°C	THA
Temperature Hot leg B	°C	THB
Temperature Cold leg A	°C	TCA
Temperature Cold leg B	°C	TCB
Press Reactor building (bar)	bar	PRB
Pressure Steam generator A	bar	PSGA
Pressure Steam generator B	bar	PSGB
Power SG A heat removal	MW	QMGA
Power SG B heat removal	MW	QMGB
Flow Total break entering RB (t/hr)	t/hr	WBK
High pressure safety injection system	t/h	WHPI
Press RCS	bar	P
Level SG A narrow range	%	NSGA

Parameter	Units	Name
Level SG B narrow range	%	NSGB

The next tables show all the results used for this analyses.

Table A.2 shows selected parameter values (set 1): P, TAVG, THA/B, TCA/B.

Table A.2 – Selected parameter values for small main steam line break (set 1).

TIME	P	TAVG	THA	THB	TCA	TCB
0	155	301	319,6812134	319,6812134	282,3187866	282,3187866
5	154,9538116	300,9431763	319,6286011	319,6286011	282,3198853	282,3198853
10	154,9610443	300,9573669	319,5891418	319,5891418	282,3283691	282,3283691
15	154,9762115	300,9732056	319,5892334	319,5892334	282,3413391	282,3413391
20	154,9749603	300,9695435	319,5858154	319,5858154	282,3524475	282,3524475
25	154,973877	300,9682312	319,577301	319,577301	282,3596802	282,3596802
30	154,9779968	300,9729004	319,5746155	319,5746155	282,365448	282,365448
35	154,9810791	300,9754028	319,5757751	319,5757751	282,3702698	282,3702698
40	154,9811859	300,9744873	319,5747986	319,5747986	282,3735657	282,3735657
45	154,9817352	300,9744873	319,5727234	319,5727234	282,3757935	282,3757935
50	154,9833527	300,975769	319,5723572	319,5723572	282,3774414	282,3774414
55	154,9844818	300,9762268	319,5726318	319,5726318	282,3786621	282,3786621
60	154,9849854	300,9759827	319,5722656	319,5722656	282,3796082	282,3796082
65	154,9856415	300,9761353	319,5717468	319,5717468	282,380188	282,380188
70	154,9864807	300,9764709	319,5716553	319,5716553	282,3807373	282,3807373
75	154,9871216	300,9765625	319,5716858	319,5716858	282,3811646	282,3811646
80	154,9876251	300,9765625	319,5715332	319,5715332	282,3815002	282,3815002
85	154,9881287	300,9765625	319,5714111	319,5714111	282,3817444	282,3817444
90	154,9886475	300,9765625	319,5713501	319,5713501	282,3818054	282,3818054
95	154,9893188	300,9766846	319,5712891	319,5712891	282,3819275	282,3819275
100	154,9898224	300,9766846	319,5712891	319,5712891	282,382019	282,382019
105	154,8852081	300,8262939	319,9126282	319,5210876	281,9560852	282,3476563
110	154,6977081	300,6142578	320,2662659	319,3126221	281,2935181	282,2471619
115	154,6214447	300,522644	320,5811768	319,1362305	280,6982727	282,143158
120	154,5709076	300,4457092	320,8529053	319,0178223	280,2246094	282,0596924
125	154,521225	300,3697815	321,0427551	318,9085388	279,8600464	281,9942932
130	154,4923706	300,3166199	321,1763916	318,8148193	279,5831299	281,9447327
135	154,4777069	300,2766113	321,2764282	318,7417603	279,3739624	281,9086914
140	154,4689484	300,2421265	321,3486633	318,6811523	279,2149353	281,8824768
145	154,4658661	300,213562	321,3998413	318,6290588	279,0924377	281,8632507
150	154,4671173	300,18927	321,436676	318,5841675	278,996582	281,8490601
155	154,4709167	300,1676941	321,4628601	318,5444946	278,9198914	281,8382568
160	154,4769592	300,1485901	321,4814148	318,5088501	278,8572998	281,8298645
165	154,4844971	300,1311646	321,4946594	318,4764404	278,8049927	281,8231812
170	154,4927826	300,1145935	321,5036926	318,4461975	278,7602234	281,817688

TIME	P	TAVG	THA	THB	TCA	TCB
175	154,5015411	300,0987549	321,5093689	318,4173584	278,7209473	281,8129272
180	154,5107422	300,0835571	321,5126648	318,3897705	278,6856689	281,8086243
185	154,5201569	300,0688171	321,5141296	318,3631897	278,6535645	281,8045654
190	154,5297089	300,0543213	321,5141602	318,3373718	278,6238098	281,8006897
195	154,5393066	300,0401001	321,5131531	318,3122253	278,5958557	281,7967529
200	154,5488892	300,0261536	321,5110779	318,2875671	278,569458	281,7929688
205	154,5583801	300,0122375	321,5081787	318,2633972	278,5442505	281,7891235
210	154,5677948	299,9986572	321,5046997	318,2396851	278,52005	281,7850952
215	154,5771179	299,9850769	321,5040283	318,2192078	278,4934082	281,7782288
220	154,5863342	299,9715271	321,5053711	318,2013245	278,4649048	281,7689514
225	154,5954437	299,9582214	321,5071411	318,1846619	278,4361572	281,758667
230	154,6044617	299,9450073	321,5088196	318,1685181	278,4077759	281,7480164
235	154,6132813	299,9317932	321,5102539	318,1529236	278,3798523	281,7371216
240	154,6220398	299,9185486	321,5110779	318,1375122	278,3525391	281,7260742
245	154,630722	299,9056396	321,5114441	318,1224976	278,3258667	281,7149048
250	154,6392059	299,8926392	321,5115051	318,1077576	278,2998352	281,7036743
255	154,6474609	299,8797302	321,5110474	318,0932312	278,2743835	281,6921997
260	154,6556549	299,8668518	321,5101318	318,0790405	278,2494202	281,680542
265	154,6637268	299,8539734	321,508728	318,065033	278,2250366	281,6687622
270	154,6717529	299,8413391	321,5069885	318,0513611	278,2011719	281,6567993
275	154,6795654	299,8285217	321,5047913	318,0379333	278,1778564	281,6447144
280	154,6872559	299,815979	321,5022583	318,0248413	278,1550598	281,6323853
285	154,6947479	299,8033447	321,4992981	318,0119934	278,1327515	281,6199951
290	154,7020721	299,7907715	321,4959412	317,9994202	278,1108093	281,6073303
295	154,7093048	299,7781982	321,4922485	317,9870911	278,0892944	281,5944824
300	154,7164001	299,7656555	321,4881592	317,9749146	278,0682678	281,5814819
305	154,7234192	299,7531128	321,4836426	317,9631348	278,047699	281,5682068
310	154,7303162	299,7407837	321,4789124	317,9516296	278,0274658	281,5547485
315	154,7370758	299,7282715	321,4739075	317,9403381	278,0076294	281,5411072
320	154,7436676	299,7159119	321,4684753	317,9293213	277,9881897	281,5273438
325	154,7500763	299,7035828	321,4627991	317,9185181	277,9690552	281,5133362
330	154,7563629	299,6911316	321,4567871	317,907959	277,9503479	281,4992065
335	154,7625122	299,678894	321,4505005	317,8976135	277,9318848	281,4848328
340	154,7684937	299,6664429	321,4440308	317,8875427	277,9136658	281,4702148
345	154,7743835	299,6542053	321,4372253	317,877655	277,895813	281,4553833
350	154,7800903	299,6419067	321,4302368	317,868042	277,8782349	281,4404602
355	154,7856445	299,6295166	321,4228516	317,8584595	277,8608704	281,425293
360	154,7911377	299,6173096	321,4153748	317,8492432	277,8437805	281,4099121
365	154,7964172	299,6048584	321,4076233	317,8400879	277,8268738	281,3944092
370	154,8016357	299,5926514	321,3997498	317,8311768	277,8101807	281,3786316
375	154,8067169	299,5803223	321,3916321	317,8225708	277,7936401	281,3627625
380	154,8115997	299,5680237	321,3833008	317,8139648	277,7773438	281,3467102
385	154,8164368	299,5557861	321,3749695	317,8056641	277,7611694	281,3304443
390	154,8211517	299,543335	321,366272	317,7974243	277,7450867	281,3139648
395	154,8257599	299,5311279	321,3575134	317,7893066	277,729248	281,2974854

TIME	P	TAVG	THA	THB	TCA	TCB
400	154,8302002	299,5186462	321,3486633	317,7814026	277,7134705	281,2807007
405	154,8345795	299,5064392	321,3396912	317,7736816	277,6977539	281,2637939
410	154,8388214	299,4939575	321,3305969	317,7659912	277,6821899	281,2467651
415	154,8430176	299,4817505	321,3213196	317,7584534	277,666748	281,2295837
420	154,8470459	299,4692383	321,3118896	317,7510071	277,6514282	281,2123413
425	154,8510132	299,4569702	321,3024902	317,7437439	277,6360779	281,1949158
430	154,8548737	299,4444275	321,2929993	317,7364502	277,6207275	281,1773071
435	154,8586578	299,4321899	321,2835083	317,7293701	277,6054993	281,1596375
440	154,8622894	299,4196167	321,2738953	317,7223816	277,5903015	281,1418762
445	154,8658142	299,4072876	321,2641907	317,7153931	277,5751343	281,1239624
450	154,8693237	299,3947754	321,2544556	317,7085571	277,5600281	281,105957
455	154,8726959	299,3822632	321,2445984	317,7016602	277,5448914	281,0878296
460	154,8760376	299,369873	321,2348328	317,6949768	277,5298462	281,0696411
465	154,8792419	299,3573303	321,2249451	317,6882935	277,5147705	281,0513916
470	154,882431	299,3447876	321,2151489	317,6816406	277,4995422	281,0329895
475	154,8861084	299,3334045	321,2055969	317,6753845	277,4846497	281,0148621
480	154,8917084	299,3247681	321,1976013	317,6708679	277,471283	280,9979858
485	154,8990936	299,3186646	321,191864	317,6688843	277,4603577	280,9832458
490	154,9062042	299,3121338	321,1868286	317,6679077	277,4513245	280,9701843
495	154,9125214	299,3050232	321,1812439	317,6664429	277,4429321	280,9577637
500	154,9189758	299,2984619	321,1753235	317,6645508	277,4350281	280,9457397
505	154,9255219	299,2923584	321,1697083	317,6629639	277,4277039	280,9344177
510	154,9318085	299,2860718	321,1639404	317,6611938	277,4207153	280,9234924
515	154,9385223	299,2807617	321,1585388	317,659668	277,4142456	280,9130859
520	154,945755	299,2764587	321,1538391	317,658905	277,4085999	280,9035339
525	154,9533997	299,2732544	321,1498718	317,658844	277,4040222	280,89505
530	154,9612274	299,270813	321,1467896	317,659668	277,4006653	280,8878174
535	154,9694214	299,2689514	321,1440735	317,6607666	277,3982849	280,8815918
540	154,9780273	299,2678833	321,1416931	317,662323	277,3970947	280,8764954
545	154,9863434	299,2669678	321,139801	317,6642151	277,3963928	280,8720093
550	154,9948425	299,2667236	321,1381226	317,6662598	277,3964539	280,8683472
555	155,0033417	299,2667236	321,1367188	317,668396	277,3972778	280,8654785
560	155,0116119	299,2667236	321,1352539	317,6704407	277,3984985	280,8631592
565	155,0196686	299,2667236	321,1336975	317,6723328	277,3998413	280,861145
570	155,0275879	299,2667236	321,1321411	317,6740112	277,4013367	280,859436
575	155,0354919	299,2667236	321,1306458	317,6756287	277,402832	280,8578491
580	155,0432892	299,2668762	321,1292725	317,6771545	277,4043884	280,8565063
585	155,0509644	299,2669678	321,1278992	317,6784973	277,4058838	280,8551331
590	155,0585175	299,2670898	321,1265564	317,6798706	277,4073486	280,8540039
595	155,0659332	299,2671814	321,1251831	317,6811523	277,408783	280,8529358
600	155,0731964	299,2672424	321,1238708	317,682251	277,4103394	280,8519592
605	155,0803528	299,267334	321,1226196	317,6833496	277,4118347	280,8510742
610	155,0874023	299,2674255	321,12146	317,6843872	277,413208	280,8502502
615	155,0943146	299,2675171	321,1204224	317,6854553	277,4145203	280,8494568
620	155,1010742	299,2676086	321,1193848	317,6864624	277,4156799	280,8486633

TIME	P	TAVG	THA	THB	TCA	TCB
625	155,1077576	299,2677002	321,1183777	317,6875	277,416748	280,8479004
630	155,1143188	299,2678223	321,1174316	317,6882935	277,4178162	280,847168
635	155,1207581	299,2678223	321,1166382	317,6891479	277,4188232	280,8464966
640	155,1270905	299,2679443	321,1157532	317,6898499	277,4199219	280,8458557
645	155,1333313	299,2679443	321,1149597	317,6905518	277,420929	280,8451843
650	155,139389	299,2680969	321,1141357	317,6912537	277,4218445	280,8446045
655	155,1453705	299,2680969	321,1134033	317,691925	277,4227905	280,8441467
660	155,1512756	299,2681885	321,1127625	317,6925964	277,4235229	280,8436279
665	155,1570587	299,2681885	321,1120605	317,6932373	277,4241943	280,8431396
670	155,1627808	299,2683411	321,1114807	317,6938171	277,4248657	280,8426514
675	155,1683502	299,2683411	321,1109924	317,6943665	277,4255371	280,8422852
680	155,1738281	299,2683411	321,1105042	317,6947632	277,4261475	280,8418884
685	155,1792145	299,2684631	321,110199	317,6954346	277,4266052	280,8413391
690	155,1844788	299,2684631	321,1098633	317,6959534	277,4269409	280,8409729
695	155,1896973	299,2684631	321,1095276	317,6963501	277,4272766	280,8406067
700	155,1948547	299,2685242	321,1091614	317,6966858	277,4277954	280,840271
705	155,1999054	299,2685242	321,1088257	317,6970215	277,4282532	280,8399048
710	155,2048645	299,2686157	321,10849	317,6973877	277,4286194	280,8395996
715	155,2097473	299,2686157	321,1081238	317,6977234	277,4289551	280,8393555
720	155,2145386	299,2686768	321,1079102	317,6980591	277,4292603	280,8391113
725	155,2192535	299,2686768	321,1078186	317,6983948	277,4295044	280,8387756
730	155,3966675	299,6571045	320,4384766	317,0724792	278,2018738	281,567749
735	156,2793579	300,6149597	320,2272339	316,8603516	279,7531128	283,1199341
740	155,9128265	300,2395935	320,3242493	316,9085693	280,1714478	283,5870667
745	155,5376892	300,0071716	320,1392517	316,6687012	280,128479	283,5990601
750	155,575531	299,9951782	320,1244507	316,6035461	279,9759521	283,4969482
755	155,5964966	299,9196472	320,1750183	316,6221924	279,8083191	283,3612061
760	155,5703735	299,8072815	320,1943054	316,6225281	279,6130981	283,1848755
765	155,5520325	299,7058411	320,21698	316,640625	279,3929138	282,9692688
770	155,53508	299,6028442	320,2431641	316,6873474	279,1661987	282,7220154
775	156,7651367	301,2436218	314,9709473	312,4476624	285,466217	287,9894714
780	155,5157471	299,5177917	310,7883301	308,7043762	289,7930908	291,8770447
785	153,0955048	296,9700928	306,9265442	304,9368591	290,7316895	292,7213135
790	151,1732178	294,7918701	303,1861877	301,3559265	290,4594727	292,2897034
795	149,7420197	293,0315247	299,9847717	298,4779663	289,7849121	291,2917175
800	148,4785767	291,497406	297,384491	296,2304688	288,9024963	290,0565186
805	147,4520569	290,1938477	295,2313843	294,2935791	288,0070496	288,9447632
810	146,6164703	289,0832825	293,4436035	292,6376343	287,1707764	287,9766541
815	146,0631256	288,3260498	291,4153748	291,2981873	287,0274658	287,1446228
820	145,8845062	287,8591614	289,9671021	290,4747314	287,0195618	286,5118713
825	145,6977081	287,3652954	289,1419678	289,8549194	286,6860657	285,9730835
830	145,5097809	286,8603516	288,5436401	289,2895203	286,2212524	285,4753418
835	145,3249512	286,3557739	288,0215759	288,7277527	285,711853	285,0057068
840	145,1515045	285,8633423	287,5221558	288,1546631	285,2022095	284,5696411
845	144,9903259	285,3813477	287,0337524	287,6005859	284,7059631	284,1390686

TIME	P	TAVG	THA	THB	TCA	TCB
850	144,8301544	284,8979797	286,5501709	287,0768433	284,2166748	283,6899414
855	144,6694641	284,4126892	286,066803	286,5662842	283,7295227	283,230011
860	144,5081177	283,9255371	285,581543	286,0601196	283,2426147	282,7640076
865	144,3476868	283,4383545	285,0909119	285,5552368	282,759613	282,2952576
870	144,1880035	282,9501648	284,6020508	285,0575867	282,2740479	281,818512
875	144,0271606	282,4567871	284,1170044	284,5705566	281,7796936	281,3261719
880	143,8696442	281,955719	283,6291199	284,0870972	281,277832	280,8198853
885	143,7160339	281,4472961	283,1342163	283,6001892	280,7696838	280,3036804
890	143,5635376	280,9325562	282,6314392	283,1058044	280,2557678	279,7814026
895	143,4103394	280,4170532	282,1160278	282,5950928	279,745636	279,2665405
900	143,2580719	279,9021606	281,5945435	282,0765991	279,2385864	278,7565613
905	143,106781	279,3878784	281,071228	281,5557251	278,7331543	278,2487183
910	142,9564362	278,8742371	280,545929	281,0344238	278,2302551	277,7418518
915	142,8072357	278,3614197	280,0220337	280,5133667	277,7271118	277,2358704
920	142,6593018	277,8494873	279,4992371	279,9929504	277,2244263	276,7308044
925	142,5126953	277,338562	278,9825134	279,4804382	276,7174988	276,2196045
930	142,3679199	276,8240967	278,4716797	278,9811401	276,2039185	275,6944885
935	142,2272491	276,302063	277,9584045	278,4822998	275,6838989	275,1600342
940	142,092804	275,7754211	277,4404907	277,9745178	275,1580811	274,6240845
945	141,963028	275,24823	276,9154053	277,454071	274,6324768	274,0938721
950	141,8383942	274,7269897	276,3818054	276,9190674	274,1174316	273,5802612
955	141,7194061	274,2115784	275,8476257	276,3833313	273,6114197	273,0757446
960	141,6053009	273,7011414	275,3167725	275,8520203	273,1117249	272,5764771
965	141,4954834	273,1949158	274,791687	275,3264465	272,6155701	272,0808105
970	141,3882294	272,6906738	274,2748718	274,8057251	272,1182861	271,5874939
975	141,2823944	272,1875305	273,7633057	274,2879333	271,6200562	271,0954895
980	141,1752319	271,6808777	273,2626648	273,78479	271,1111755	270,5890503
985	141,0707245	271,1663208	272,765625	273,2894287	270,5903625	270,0665283
990	140,9744415	270,6437683	272,2658997	272,7917786	270,059021	269,5331421
995	140,8856354	270,113678	271,7614136	272,2886658	269,5180664	268,9907837
1000	140,7999573	269,5798035	271,2444153	271,769043	268,9766235	268,4519653
1005	140,7176208	269,0498962	270,7141724	271,2306519	268,4457092	267,9291992
1010	140,6388245	268,523468	270,1812744	270,6879883	267,9210205	267,4142456
1015	140,5632935	268,0004272	269,6496277	270,1461487	267,4005432	266,9040222
1020	140,4915466	267,4816589	269,1196289	269,6048279	266,8853149	266,4000549
1025	140,4247894	266,9685669	268,5939331	269,0647583	266,3747864	265,9039001
1030	140,3636322	266,461792	268,0740662	268,5280457	265,8693542	265,4154053
1035	140,3081818	265,9613647	267,5605469	267,9968872	265,3697815	264,9334717
1040	140,2576447	265,4659729	267,0532532	267,4749756	264,8756104	264,4539185
1045	140,2069244	264,9684753	266,5487976	266,9720154	264,3842468	263,9610291
1050	140,1545105	264,4685669	266,0424194	266,4741211	263,8932495	263,4615173
1055	140,1022034	263,9684143	265,5337219	265,9744873	263,4026794	262,9618835
1060	140,0513153	263,4695129	265,0239868	265,4725037	262,9133301	262,4648132
1065	140,0027161	262,9728394	264,5140381	264,9693604	262,4266052	261,9713135
1070	139,9569855	262,4790344	264,005249	264,4663696	261,9429932	261,481842

TIME	P	TAVG	THA	THB	TCA	TCB
1075	139,9144745	261,9885559	263,4998779	263,9647522	261,4614258	260,9965515
1080	139,8751984	261,5013428	262,9981689	263,4655762	260,9824219	260,5150146
1085	139,8390656	261,0172424	262,5013428	262,9710388	260,5049133	260,0351868
1090	139,8003693	260,5238953	262,0266724	262,5084839	260,0036316	259,5217896
1095	139,77211	260,0126038	261,5597534	262,0606384	259,4743958	258,9735107
1100	139,7575684	259,4820251	261,0876465	261,6107788	258,919281	258,3961487
1105	139,7514954	258,9314575	260,6058655	261,1540222	258,3377075	257,7895508
1110	139,7530975	258,3719482	260,0875549	260,6497803	257,7596741	257,1974487
1115	139,7612305	257,8216553	259,5372925	260,1008606	257,2068481	256,64328
1120	139,7763214	257,2858276	259,0346069	259,4547729	256,6155396	256,1953735
1125	139,8342438	256,8198242	258,715271	258,596405	255,9107513	256,0296021
1130	139,9085693	256,3740845	258,3708801	257,8837585	255,3037415	255,7908478
1135	139,9920502	255,942627	258,0183716	257,2599487	254,7531891	255,5116272
1140	140,0820313	255,5222778	257,6577148	256,6951599	254,2440491	255,2066345
1145	140,1784515	255,1133118	257,2869568	256,1738586	253,7717133	254,8847961
1150	140,2805176	254,7142792	256,9118347	255,6868286	253,3270874	254,5520782
1155	140,3862762	254,3222809	256,5376587	255,2264099	252,9005127	254,2117615
1160	140,4942474	253,9352417	256,1653137	254,7857513	252,4863739	253,8659363
1165	140,6035461	253,5520782	255,7943115	254,3595734	252,0815887	253,5163269
1170	140,7136688	253,1722107	255,4238434	253,9442749	251,6846619	253,1642151
1175	140,8244476	252,7953796	255,0536652	253,5374298	251,2944794	252,81073
1180	140,9357605	252,4215088	254,6838684	253,1375427	250,9103394	252,4566345
1185	141,0475311	252,0505219	254,314682	252,7436218	250,531601	252,1026611
1190	141,1596527	251,682373	253,9464111	252,35495	250,1578064	251,7492676
1195	141,2721405	251,3171844	253,5791321	251,9710846	249,7888489	251,3968811
1200	141,384613	250,9540558	253,2154541	251,5921478	249,4217987	251,045105
1205	141,4946747	250,5893402	252,85849	251,2160339	249,0496674	250,6921082
1210	141,6021423	250,2234344	252,5010681	250,8408966	248,6767426	250,3369141
1215	141,7075958	249,8572083	252,1404266	250,4665527	248,3058014	249,9796906
1220	141,8117523	249,4919586	251,7753448	250,0935822	247,9394073	249,6212006
1225	141,9153595	249,1286926	251,4068909	249,7229614	247,5785065	249,2624207
1230	142,0187531	248,7679749	251,0367432	249,3554077	247,2228851	248,9042053
1235	142,1221008	248,4100952	250,6664886	248,9914703	246,8722229	248,5472717
1240	142,2254486	248,0552216	250,2972107	248,6312256	246,5260925	248,1920624
1245	142,3287964	247,7033997	249,9296417	248,2748108	246,1840668	247,8388977
1250	142,4320984	247,3545074	249,5645905	247,9220886	245,845459	247,4880066
1255	142,53508	247,0083008	249,2024536	247,5727386	245,5096436	247,1393738
1260	142,637558	246,6646271	248,8431702	247,2265167	245,1763153	246,7929993
1265	142,7393951	246,3233643	248,4866791	246,8830414	244,8453217	246,4489594
1270	142,8405457	245,9845734	248,1328888	246,5419922	244,516571	246,1075134
1275	142,9409332	245,6482391	247,7817535	246,2032776	244,190094	245,7685852
1280	143,0404968	245,3143616	247,4333038	245,8669434	243,8658752	245,432251
1285	143,1392212	244,9829559	247,0874939	245,5329437	243,5439453	245,0985107
1290	143,2369843	244,654007	246,7442932	245,2013092	243,2243195	244,7673035
1295	143,3337555	244,3275452	246,4037018	244,8720703	242,9070282	244,4386749

TIME	P	TAVG	THA	THB	TCA	TCB
1300	143,4294739	244,0035553	246,0657196	244,5452118	242,5920868	244,1126099
1305	143,5240479	243,6820374	245,7303619	244,2207642	242,2794952	243,7891083
1310	143,6174316	243,3630219	245,3975677	243,8987122	241,9692535	243,4681396
1315	143,709549	243,0464935	245,0673676	243,579071	241,6614075	243,149704
1320	143,8003387	242,7324524	244,7397766	243,2619171	241,355957	242,8338165
1325	143,8898163	242,42099	244,4147797	242,9469604	241,0529022	242,5207367
1330	143,9781342	242,1125031	244,0926208	242,6335602	240,7524109	242,2114563
1335	144,0655975	241,807373	243,7735596	242,3220367	240,454834	241,9063721
1340	144,1524048	241,5058441	243,4580688	242,0128937	240,1604156	241,6056061
1345	144,2388153	241,2080383	243,1462708	241,7066345	239,8694153	241,3090057
1350	144,3248749	240,9139709	242,8383179	241,403656	239,5818634	241,016449
1355	144,4105072	240,6236267	242,5342407	241,1042633	239,2978363	240,7277527
1360	144,4956818	240,3369904	242,234024	240,8084869	239,017334	240,4428558
1365	144,5802307	240,0538483	241,9376221	240,5166473	238,7403107	240,1612701
1370	144,6638947	239,7740173	241,6448364	240,2289886	238,466629	239,8824615
1375	144,7461243	239,4968262	241,3564758	239,945282	238,1948853	239,6060944
1380	144,8259125	239,2212372	241,0724335	239,6645203	237,9235687	239,3314972
1385	144,9031067	238,9473419	240,7906952	239,3861237	237,6537933	239,0583801
1390	144,9776611	238,6751862	240,5106506	239,1099091	237,3859711	238,7867279
1395	145,04953	238,4048462	240,2321167	238,8358307	237,1202545	238,5165405
1400	145,1186218	238,1363525	239,9550629	238,5638123	236,8566437	238,2479095
1405	145,1849213	237,8696899	239,6795349	238,2938538	236,5951385	237,980835
1410	145,248291	237,6049194	239,4056396	238,0259552	236,3358002	237,7154236
1415	145,3087006	237,3420715	239,1334381	237,7601166	236,0785217	237,451828
1420	145,3660278	237,081131	238,8629456	237,4963074	235,8233032	237,1899719
1425	145,4202728	236,8221741	238,5942688	237,2344055	235,5701447	236,9300079
1430	145,4713745	236,5652161	238,3274536	236,974472	235,3190918	236,6720581
1435	145,5191803	236,3103027	238,0625458	236,7165985	235,0700989	236,4160614
1440	145,6281738	236,052536	237,7981567	236,4595947	234,8223877	236,1609802
1445	145,8134766	235,7924347	237,5302582	236,1990204	234,5726624	235,9039001
1450	146,007019	235,5354767	237,2623749	235,9387817	234,3238068	235,6473846
1455	146,2078857	235,2815247	236,9963379	235,6807861	234,0771942	235,3927002
1460	146,416153	235,0305023	236,7328186	235,4256439	233,8332214	235,1403656
1465	146,6319427	234,7823181	236,4720764	235,1735687	233,5920105	234,8905029
1470	146,8553619	234,5368347	236,2141113	234,9246521	233,3535461	234,6430054
1475	147,0865021	234,2940216	235,9589386	234,6786499	233,1177063	234,3979797
1480	147,3254852	234,0538025	235,7065277	234,4354553	232,8844147	234,1554565
1485	147,4650574	233,8150787	235,4563446	234,194458	232,653183	233,9150696
1490	147,5851593	233,579361	235,2087402	233,9559326	232,4242706	233,6770935
1495	147,7051849	233,3457031	234,9636536	233,7198181	232,1975555	233,4414063
1500	147,8247833	233,1118622	234,7332458	233,4865112	231,9592743	233,2060089
1505	147,9451447	232,8733826	234,5171204	233,256485	231,7041626	232,9647369
1510	148,0652161	232,6282349	234,3039246	233,0266113	231,4373627	232,7146454
1515	148,1853638	232,3769836	234,0895844	232,7915955	231,1606293	232,4586029
1520	148,3059387	232,1200562	233,8738098	232,5498962	230,8739014	232,1977844

TIME	P	TAVG	THA	THB	TCA	TCB
1525	148,4263763	231,8578644	233,6565552	232,3015137	230,5775452	231,9326172
1530	148,5461884	231,5905609	233,4366455	232,0467377	230,2733154	231,6632538
1535	148,665451	231,3180237	233,2151794	231,7857819	229,9601593	231,3895721
1540	148,784256	231,0406036	232,9902344	231,5182037	229,6401825	231,1122437
1545	148,9059601	230,7644958	232,7327271	231,2425232	229,3469696	230,8371582
1550	149,0313416	230,4923401	232,457489	230,9648895	229,0735779	230,5661621
1555	149,1578064	230,2243347	232,1783447	230,6890717	228,8099518	230,2991943
1560	149,2850647	229,9602814	231,9020844	230,4165344	228,5506439	230,0361938
1565	149,4130249	229,6999969	231,6290894	230,1477051	228,2955933	229,7769928
1570	149,5415192	229,4433136	231,3590088	229,8827057	228,0450134	229,5213165
1575	149,6704407	229,1899567	231,0924683	229,6213837	227,7979736	229,269043
1580	149,7996674	228,9397888	230,8295135	229,3636322	227,5540161	229,0199127
1585	149,9291229	228,6926727	230,5701141	229,1091919	227,3129578	228,7738342
1590	150,0587463	228,4484863	230,3140564	228,8580322	227,0746307	228,5306396
1595	150,188446	228,2071991	230,0619965	228,6099548	226,8382263	228,2902374
1600	150,3151703	227,9687805	229,8136597	228,3652344	226,6039581	228,0523529
1605	150,4169312	227,7315063	229,5666962	228,12323	226,3728027	227,8162537
1610	150,5188141	227,4963684	229,3213806	227,8835297	226,1438293	227,5816803
1615	150,6202698	227,2633362	229,0781555	227,646286	225,9168549	227,3486938
1620	150,7212524	227,0322876	228,8370972	227,4114532	225,6917877	227,1174164
1625	150,8217163	226,8031006	228,5981445	227,178894	225,4685669	226,8877716
1630	150,9216156	226,5756683	228,3611908	226,9484406	225,2470398	226,6597595
1635	151,020813	226,3499146	228,1261292	226,7199249	225,0270844	226,4333344
1640	151,1193695	226,1257935	227,8940277	226,4932251	224,8076477	226,2084503
1645	151,2176666	225,9033051	227,6640167	226,2683411	224,5894165	225,9850769
1650	151,3156433	225,682373	227,4347992	226,0451355	224,3735809	225,7632294
1655	151,4132996	225,4629517	227,2068787	225,8235474	224,1595306	225,5428925
1660	151,5106049	225,2450256	226,980423	225,6035614	223,9471283	225,3240051
1665	151,6075439	225,0285645	226,7554779	225,3850861	223,7361908	225,1065979
1670	151,7097626	224,8136292	226,532074	225,1681061	223,5266571	224,8906403
1675	151,8317108	224,6013641	226,3107758	224,9532318	223,3190155	224,6765594
1680	151,9532471	224,3906097	226,0915222	224,740387	223,113205	224,4643555
1685	152,0747833	224,1813202	225,875473	224,5292206	222,907486	224,2536926
1690	152,1963196	223,973526	225,6607666	224,3196411	222,7035675	224,0446777
1695	152,3177185	223,7671661	225,4469299	224,1115417	222,5017548	223,8371277
1700	152,4389191	223,5621033	225,2345276	223,9048157	222,3012848	223,6310272
1705	152,5593567	223,3583221	225,0234985	223,6993866	222,1021271	223,4262695
1710	152,6789856	223,155838	224,8138123	223,4952393	221,9042664	223,2228546
1715	152,7978363	222,9546814	224,6053925	223,2923584	221,7077332	223,0207825
1720	152,9159241	222,7548218	224,3986053	223,0907593	221,5121918	222,8200378
1725	153,0332947	222,556366	224,1947174	222,8904877	221,316452	222,6206512
1730	153,1499481	222,3592224	223,9910278	222,6915436	221,1231842	222,4226227
1735	153,2658844	222,1633911	223,7882385	222,4939117	220,9316711	222,2259369
1740	153,3810577	221,9688263	223,5868988	222,2976227	220,7413177	222,0305939
1745	153,4951935	221,7750092	223,3877563	222,1023407	220,5509644	221,8363647

TIME	P	TAVG	THA	THB	TCA	TCB
1750	153,5288544	221,5788879	223,1887817	221,9067535	220,3602295	221,6422424
1755	153,5584412	221,3822937	222,9884033	221,7095795	220,1685333	221,4473419
1760	153,5880737	221,1866455	222,7878571	221,5122681	219,9770813	221,2526703
1765	153,6177673	220,9919281	222,5877075	221,3154755	219,7863464	221,0585785
1770	153,6475525	220,798172	222,3882141	221,1195526	219,5965729	220,8652496
1775	153,6774597	220,6053925	222,1895294	220,9245758	219,4078064	220,6728058
1780	153,707428	220,4135895	221,9917297	220,7305603	219,2200928	220,4812775
1785	153,7376709	220,2227936	221,7948456	220,5375671	219,0334167	220,2906799
1790	153,7692719	220,0328674	221,5988617	220,3455658	218,8477325	220,101059
1795	153,8023987	219,8429871	221,4098053	220,1548157	218,6564789	219,9114838
1800	153,8358459	219,6515503	221,2302704	219,9642944	218,4548798	219,7208252
1805	153,8694763	219,458374	221,0548096	219,7738495	218,2468719	219,5278168
1810	153,9024658	219,2621613	220,8797455	219,5843658	218,0344086	219,3297729
1815	153,9342499	219,0630798	220,7024689	219,3928223	217,8188934	219,1285248
1820	153,9646912	218,8614044	220,5231934	219,1981964	217,6000671	218,9250641
1825	153,9938812	218,6573944	220,3421936	219,0003357	217,3779449	218,7198334
1830	154,0218201	218,4512177	220,1597443	218,799408	217,1525421	218,5128937
1835	154,0486603	218,2430267	219,97612	218,5956726	216,9239655	218,3044281
1840	154,0745392	218,0329132	219,7915649	218,3893738	216,692276	218,0944672
1845	154,0995331	217,8209381	219,6062622	218,1807404	216,4574585	217,8829803
1850	154,1241455	217,6081696	219,4112549	217,9692535	216,2290955	217,6710968
1855	154,149826	217,3970032	219,2013092	217,7561798	216,0155182	217,4606323
1860	154,1765594	217,187439	218,9867096	217,5437012	215,8085632	217,2515869
1865	154,2041016	216,9793091	218,7713165	217,3324585	215,605011	217,0438538
1870	154,2313995	216,7726746	218,5566559	217,122757	215,4035187	216,8374176
1875	154,2582245	216,5675049	218,343338	216,9146423	215,2036133	216,6322937
1880	154,2845764	216,3637848	218,1315155	216,7080841	215,0051117	216,4284821
1885	154,3103943	216,1614685	217,9212341	216,5031128	214,8078918	216,2259979
1890	154,3357086	215,9605408	217,7124939	216,2995605	214,611969	216,0249023
1895	154,3605957	215,7610474	217,5052948	216,0971832	214,4173279	215,8254395
1900	154,3850403	215,5631104	217,2997284	215,8959656	214,2240143	215,6278076
1905	154,4091644	215,366684	217,0958099	215,6959991	214,032074	215,4319
1910	154,4329834	215,1719666	216,893631	215,4973907	213,841568	215,2378082
1915	154,4564819	214,978775	216,693161	215,3002167	213,6525421	215,0454559
1920	154,4797363	214,7872772	216,4943695	215,1045227	213,4650116	214,8548126
1925	154,5027008	214,5973816	216,2973633	214,9104309	213,279007	214,6658478
1930	154,5254517	214,4091034	216,1020966	214,717926	213,0944672	214,4785919
1935	154,5479126	214,2223816	215,9085236	214,526947	212,9114532	214,292923
1940	154,5701599	214,0372467	215,7166443	214,3376617	212,7298889	214,1088409
1945	154,5921173	213,8536224	215,5263824	214,1499023	212,5498199	213,9262543
1950	154,6138153	213,6714783	215,3377686	213,9637756	212,3711395	213,7451019
1955	154,6352692	213,4907532	215,1506958	213,7792206	212,1938477	213,5653229
1960	154,6564026	213,3114319	214,9651642	213,5961456	212,0179291	213,3869171
1965	154,6772766	213,1334839	214,7810822	213,4145508	211,8433228	213,2098236
1970	154,697876	212,9568939	214,5984497	213,2344055	211,6700134	213,0340576

TIME	P	TAVG	THA	THB	TCA	TCB
1975	154,7181854	212,781601	214,4172363	213,0556793	211,4980011	212,8595581
1980	154,7382202	212,6075897	214,2374115	212,8783112	211,3272095	212,6863251
1985	154,7579803	212,4348602	214,0589447	212,7022858	211,1576538	212,514328
1990	154,7774353	212,2633362	213,8818054	212,5276031	210,9893036	212,3435059
1995	154,7965698	212,0929718	213,7059174	212,3543396	210,8220825	212,1736908
2000	154,8153687	211,9236755	213,53125	212,1824036	210,6559448	212,0047913
2005	154,8338318	211,7553711	213,357666	212,0117645	210,4908447	211,8367615
2010	154,8519135	211,588028	213,1851654	211,8423157	210,3266907	211,6695404
2015	154,8696136	211,4215546	213,0136261	211,6739655	210,1634216	211,5030823
2020	154,8869324	211,2559509	212,8430634	211,5066376	210,0010223	211,3374329
2025	154,9038696	211,091156	212,6733856	211,3402863	209,839447	211,1725464
2030	154,9204102	210,9272156	212,5045776	211,1748505	209,6786652	211,0084076
2035	154,9365845	210,7640228	212,3366547	211,0102997	209,5186615	210,8450012
2040	154,9523926	210,6016083	212,1694946	210,8466034	209,3593903	210,6823273
2045	154,9678345	210,4399109	212,0031738	210,68367	209,2008362	210,5203705
2050	154,9829254	210,2789917	211,837677	210,5215607	209,042984	210,3591003
2055	154,9976501	210,1187897	211,6729126	210,3602295	208,8858643	210,1985626
2060	155,0121918	209,9593048	211,5089111	210,1996613	208,7294464	210,0387115
2065	155,0268555	209,8005524	211,3459473	210,0398407	208,5734558	209,8795471
2070	155,0417328	209,642746	211,1852722	209,8804474	208,416748	209,7216034
2075	155,0569916	209,4861755	211,0245819	209,721283	208,2620697	209,5654144
2080	155,0725861	209,3307495	210,8646698	209,5630951	208,1088867	209,4105072
2085	155,088501	209,1764374	210,70578	209,4061127	207,9569397	209,2566376
2090	155,1046906	209,0231171	210,5479431	209,2503967	207,8060608	209,103653
2095	155,1211243	208,8707733	210,3911896	209,0958252	207,6561584	208,9515076
2100	155,1377563	208,7192841	210,2354126	208,9423676	207,5071259	208,8001709
2105	155,1605988	208,5827179	209,9765167	208,7891693	207,4716339	208,6589661
2110	155,1878357	208,4516449	209,7789459	208,6498413	207,3945007	208,5236053
2115	155,2144623	208,3200989	209,6212158	208,5163879	207,2848206	208,3896637
2120	155,2406006	208,1883392	209,4784393	208,3847809	207,162674	208,2563477
2125	155,2663422	208,0564728	209,3411713	208,2536163	207,0357513	208,1233368
2130	155,2917786	207,9247437	209,2059021	208,1225128	206,9072418	207,9906464
2135	155,3169556	207,7932281	209,0713959	207,9914093	206,7783356	207,8583374
2140	155,3419495	207,6619873	208,9371948	207,8603516	206,6495514	207,7263947
2145	155,366806	207,5310974	208,8032074	207,7294006	206,5211182	207,5949097
2150	155,3915558	207,4007111	208,6694946	207,5987244	206,3932037	207,4639435
2155	155,4162445	207,2707672	208,536087	207,468399	206,2658234	207,3334808
2160	155,4408264	207,1413422	208,4030151	207,3384705	206,1390686	207,2035828
2165	155,4653931	207,0124512	208,2703094	207,2089844	206,0129547	207,0742493
2170	155,489975	206,88414	208,138031	207,0799866	205,8874969	206,9455414
2175	155,5145569	206,7564087	208,0061951	206,9514923	205,7627106	206,8174286
2180	155,5391235	206,629303	207,8748474	206,8235474	205,6386414	206,6899567
2185	155,5637054	206,5028229	207,7440033	206,696167	205,5152588	206,5631104
2190	155,5834961	206,3656616	207,7028656	206,5714111	205,297226	206,4286652
2195	155,5982361	206,2229614	207,7814636	206,4351349	204,943222	206,289566

TIME	P	TAVG	THA	THB	TCA	TCB
2200	155,3810272	205,6650696	208,2470245	206,0987701	203,8539276	206,002182
2205	155,2311096	205,2693634	207,8738403	205,6657104	203,4376678	205,6458282
2210	155,1484985	204,9643555	207,3590851	205,2777252	203,2356262	205,3169861
2215	155,1076202	204,7169037	206,8904114	204,9577179	203,0999908	205,0327148
2220	155,0926056	204,5054779	206,5055084	204,6956024	202,9772491	204,7871399
2225	155,0932007	204,3164215	206,1955109	204,475235	202,8498535	204,5701294
2230	155,1027069	204,1420746	205,9423218	204,2836456	202,7141418	204,3727875
2235	155,1168671	203,9747009	205,7282867	204,1135254	202,5699768	204,1847076
2240	155,1330261	203,8100433	205,5389862	203,9542694	202,4178314	204,0024872
2245	155,1500397	203,6461639	205,3648987	203,7991943	202,2586212	203,8243103
2250	155,1672974	203,4819794	205,1999817	203,6447754	202,0934906	203,6487732
2255	155,184433	203,3168793	205,0402374	203,4892273	201,9235382	203,4745636
2260	155,2017975	203,1519318	204,8728638	203,3321075	201,7608337	203,3016052
2265	155,2199097	202,9878845	204,6997528	203,174118	201,6046906	203,1303253
2270	155,238678	202,8245697	204,5257568	203,0157166	201,4507294	202,9607391
2275	155,2580566	202,661972	204,3524628	202,8571014	201,2974548	202,7927704
2280	155,2779999	202,5000763	204,1802216	202,69841	201,1444855	202,6262665
2285	155,2985382	202,3389435	204,0091553	202,5398407	200,9917908	202,4611359
2290	155,3196259	202,1786346	203,8392639	202,3814392	200,8394928	202,2973022
2295	155,3408508	202,0191803	203,670517	202,2234039	200,6876678	202,1347809
2300	155,3622284	201,8605804	203,5028534	202,0657959	200,5364532	201,9734802
2305	155,3837128	201,7029266	203,3362732	201,9087372	200,3858795	201,8134155
2310	155,405304	201,5462341	203,1707916	201,7523346	200,2360992	201,6545258
2315	155,4270782	201,3905792	203,0063934	201,5966949	200,0871735	201,4968567
2320	155,4490356	201,2360077	202,8429871	201,4419098	199,9393158	201,3404083
2325	155,4712067	201,0825958	202,6806793	201,2880554	199,792572	201,1851959
2330	155,4936523	200,9303894	202,5195313	201,1352386	199,6469269	201,03125
2335	155,5163116	200,7793884	202,3596039	200,9835052	199,5024719	200,8785706
2340	155,5392609	200,6296234	202,2009735	200,8329315	199,3591461	200,7271881
2345	155,562439	200,4810638	202,0436249	200,6835175	199,2169342	200,5770721
2350	155,585907	200,3337097	201,8876038	200,5352478	199,075882	200,4282227
2355	155,5545197	200,1863708	201,7324829	200,3877869	198,9356689	200,280365
2360	155,5746155	200,0413208	201,5782928	200,2411804	198,7963562	200,1334686
2365	155,5993347	199,8975525	201,4258728	200,0960999	198,6584015	199,9881439
2370	155,5651703	199,7535706	201,2740326	199,9515839	198,5210724	199,8435516
2375	155,5905914	199,6121063	201,1238861	199,8085785	198,3850861	199,7003784
2380	155,5582275	199,4704437	200,9747314	199,6664886	198,2499542	199,5581818
2385	155,5833435	199,3311768	200,8268738	199,525528	198,1159363	199,4172058
2390	155,5571136	199,1917877	200,6804047	199,3858948	197,983017	199,2774811
2395	155,5776367	199,0546112	200,534668	199,2469177	197,8508453	199,1385651
2400	155,5570831	198,9186707	200,3907928	199,1096039	197,7200165	199,0012054
2405	155,5733795	198,7822571	200,2472382	198,9725494	197,5896454	198,8643036
2410	155,6020355	198,6483917	200,1055756	198,837204	197,4606323	198,7289886
2415	155,5705566	198,5140533	199,9643097	198,7022552	197,3321533	198,5942078
2420	155,5999603	198,3822174	199,8248444	198,5688782	197,2049866	198,4609222

TIME	P	TAVG	THA	THB	TCA	TCB
2425	155,5691528	198,2498169	199,6860657	198,4359741	197,078186	198,3282318
2430	155,5987854	198,1187897	199,5510406	198,3040771	196,9496002	198,1965637
2435	155,5675964	197,9860535	199,4162445	198,1715851	196,8200073	198,064682
2440	155,5969849	197,8550415	199,2815704	198,0394897	196,6912994	197,9333954
2445	155,5660095	197,723053	199,1460724	197,907196	196,5632782	197,8021393
2450	155,5955811	197,5932312	199,01091	197,7757263	196,4365082	197,6717072
2455	155,5649414	197,4627075	198,8756409	197,6445465	196,3105011	197,541626
2460	155,5951385	197,3344574	198,7412415	197,5144196	196,18573	197,4125366
2465	155,5649414	197,2055817	198,6070862	197,3847504	196,0616302	197,2839508
2470	155,5958252	197,0790558	198,4741058	197,2563324	195,9386902	197,1564484
2475	155,5660706	196,9518738	198,3415833	197,1284637	195,8163605	197,0294647
2480	155,5976563	196,8270569	198,2102509	197,0018005	195,6951599	196,9036102
2485	155,5681763	196,7015991	198,0792999	196,8755493	195,5744934	196,7782288
2490	155,600647	196,5784302	197,9497833	196,7506866	195,4549713	196,6540527
2495	155,5715179	196,4546204	197,8205261	196,6260834	195,3358612	196,5303192
2500	155,5552216	196,3331451	197,6928253	196,5028839	195,2179565	196,4078979
2505	155,5761108	196,2110443	197,5653076	196,3798676	195,1004028	196,2858582
2510	155,557724	196,08992	197,4393463	196,2582092	194,9839783	196,1651001
2515	155,5818939	195,9708252	197,3136902	196,1369019	194,8680878	196,0448761
2520	155,5578766	195,8513794	197,18927	196,0167389	194,7531586	195,925705
2525	155,5888977	195,7339172	197,0655518	195,897171	194,638916	195,8072662
2530	155,5626984	195,6160126	196,9427338	195,7784729	194,5254364	195,6896515
2535	155,5970917	195,5002899	196,8209229	195,6607208	194,4128113	195,5729828
2540	155,5703125	195,3839569	196,699585	195,5434418	194,3007507	195,4568634
2545	155,556839	195,2698975	196,5797119	195,4275055	194,1898041	195,3419647
2550	155,5810089	195,1551666	196,460022	195,3117981	194,0792084	195,227417
2555	155,5594635	195,0414124	196,341568	195,1972351	193,969574	195,1139221
2560	155,5942078	194,9295654	196,2238312	195,0833282	193,860672	195,0011444
2565	155,5700989	194,8171997	196,10672	194,9700623	193,7523499	194,8890076
2570	155,5561676	194,7057648	195,9908295	194,8579102	193,6449738	194,7778778
2575	155,5862579	194,5962372	195,8753052	194,7461548	193,5381317	194,6672821
2580	155,5645142	194,4862061	195,7607574	194,6353149	193,4320831	194,5574951
2585	155,5543365	194,3781281	195,64888	194,5254669	193,3251495	194,4485474
2590	155,5825043	194,268692	195,5417938	194,4156952	193,2134399	194,3395233
2595	155,562439	194,159317	195,4372864	194,3063812	193,0999756	194,2308807
2600	155,6025543	194,0513458	195,3337555	194,1971741	192,9859009	194,1224365
2605	155,5805969	193,9420624	195,2303162	194,087677	192,8712463	194,0138702
2610	155,5609131	193,8329926	195,1274109	193,9784698	192,7566681	193,9056244
2615	155,6017914	193,7253723	195,0248566	193,8694153	192,6421814	193,7976227
2620	155,5803223	193,6164246	194,9221954	193,7601166	192,5274048	193,6895142
2625	155,5611572	193,5076599	194,8200073	193,6511841	192,4127808	193,581604
2630	155,6025696	193,3998108	194,717926	193,543808	192,298111	193,472229
2635	155,5810394	193,2898102	194,615097	193,4363556	192,1826935	193,3614197
2640	155,5615387	193,1793976	194,5120697	193,3286438	192,066803	193,2502747
2645	155,6027222	193,0700226	194,408783	193,2203522	191,9505005	193,1389771

TIME	P	TAVG	THA	THB	TCA	TCB
2650	155,5809631	192,9588318	194,3049011	193,1110382	191,8334351	193,027298
2655	155,5613098	192,8475494	194,2011261	193,0014038	191,7160645	192,9157867
2660	155,6026459	192,7375336	194,0974121	192,891449	191,5984497	192,8044128
2665	155,5809631	192,6259003	193,9933777	192,7807465	191,4801788	192,6928101
2670	155,5614319	192,5142975	193,8896942	192,6700745	191,3618011	192,5814514
2675	155,6031189	192,4041443	193,7862549	192,5592651	191,2433014	192,4703064
2680	155,5816345	192,2923889	193,6825714	192,4479218	191,1242676	192,3589478
2685	155,5623779	192,1808014	193,5783844	192,3366852	191,0061798	192,2479095
2690	155,5531006	192,0714722	193,468338	192,2255859	190,8947906	192,137558
2695	155,5843048	191,9614563	193,3551941	192,114624	190,7870331	192,0275879
2700	155,5653381	191,8523102	193,2419739	192,0046844	190,681366	191,9186096
2705	155,5548706	191,7440033	193,1293335	191,8957214	190,5769196	191,8105164
2710	155,591095	191,6378479	193,0170135	191,7872314	190,4732208	191,7029724
2715	155,5724182	191,530899	192,9054413	191,6795197	190,3701782	191,5960693
2720	155,557251	191,4248199	192,7948761	191,5727234	190,2679138	191,490036
2725	155,6016388	191,3207703	192,6850433	191,4666901	190,1663971	191,3847351
2730	155,5837402	191,2158813	192,5756683	191,3610992	190,0652771	191,2798462
2735	155,567276	191,1116943	192,4671783	191,2563324	189,9648895	191,175766
2740	155,5552063	191,008316	192,3594666	191,1523285	189,8651276	191,0723419
2745	155,5986176	190,9068146	192,2524414	191,0488892	189,7660065	190,9695435
2750	155,5821228	190,8045197	192,1459198	190,9459839	189,6673126	190,8672791
2755	155,5668335	190,7028351	192,0401459	190,84375	189,5692444	190,7656555
2760	155,5559235	190,6018982	191,9351044	190,7421722	189,4718018	190,6646881
2765	155,6007385	190,5028229	191,8306732	190,6412201	189,3749084	190,5643463
2770	155,5850372	190,4029388	191,726532	190,5406647	189,2785492	190,4644165
2775	155,5700836	190,303772	191,6229401	190,4408417	189,1831055	190,3652039
2780	155,5578766	190,2054596	191,5200348	190,3418579	189,0885468	190,2667084
2785	155,5536804	190,1092529	191,417984	190,2437286	188,9948425	190,1690674
2790	155,5916595	190,0122833	191,3162384	190,1460266	188,9016266	190,0718231
2795	155,5773315	189,9160309	191,2153625	190,0491486	188,8091736	189,9754028
2800	155,5647278	189,8205566	191,1153412	189,953125	188,717514	189,879715
2805	155,554718	189,7258606	191,0160217	189,8577881	188,6264801	189,7847137
2810	155,6022186	189,6331177	190,91745	189,7631836	188,5361786	189,6904449
2815	155,5884857	189,5396881	190,8193817	189,6691132	188,4464111	189,5966949
2820	155,5754852	189,4469299	190,7222137	189,5758514	188,3573761	189,5037079
2825	155,5635986	189,3549042	190,6257172	189,4832916	188,2689819	189,411377
2830	155,55896	189,2635345	190,5301056	189,391571	188,1813202	189,3198395
2835	155,6035919	189,1742859	190,4349823	189,300354	188,0942688	189,2288818
2840	155,5909271	189,0841522	190,3404236	189,2096863	188,0076752	189,1384125
2845	155,5786743	188,9946899	190,2465515	189,1196899	187,9217682	189,0486145
2850	155,5671997	188,905899	190,1534271	189,030426	187,8364716	188,9594879
2855	155,5602875	188,8178711	190,061142	188,9419708	187,7519073	188,871109
2860	155,5569305	188,7317047	189,9695587	188,8541718	187,667984	188,7833862
2865	155,598877	188,6447601	189,8782959	188,7666931	187,5844574	188,6960754
2870	155,588913	188,5584412	189,7877197	188,6798859	187,5015411	188,6093903

TIME	P	TAVG	THA	THB	TCA	TCB
2875	155,5791779	188,4727325	189,6977234	188,5936584	187,4192047	188,5233002
2880	155,5703735	188,3876801	189,6085205	188,5081177	187,3374939	188,437851
2885	155,5634155	188,3032837	189,5199738	188,4233093	187,2564392	188,3530731
2890	155,5567017	188,2194519	189,4319305	188,339035	187,1759033	188,2688293
2895	155,5549011	188,1376038	189,3446503	188,2554779	187,0961151	188,1853333
2900	155,6000824	188,0549622	189,2578125	188,172348	187,0167694	188,1022491
2905	155,5914154	187,9729309	189,1715546	188,0897522	186,937973	188,0197296
2910	155,5831604	187,8914795	189,0860138	188,0079041	186,8598328	187,9379272
2915	155,5751648	187,8106384	189,0010223	187,9266205	186,7822113	187,8566589
2920	155,568573	187,730423	188,9167938	187,8460083	186,7052612	187,7760315
2925	155,5622253	187,6508179	188,8331451	187,7659607	186,6288147	187,6959991
2930	155,5571594	187,5718231	188,7500916	187,6864777	186,5529327	187,6165314
2935	155,5571136	187,4947205	188,6677704	187,6077271	186,4777222	187,5377655
2940	155,6043396	187,4167633	188,5858612	187,5293579	186,4028931	187,4593811
2945	155,5972443	187,3394012	188,5045013	187,4515533	186,328598	187,3815765
2950	155,5903931	187,2625732	188,4237366	187,3742676	186,254837	187,3043213
2955	155,5838623	187,1863403	188,3435822	187,2975922	186,1816254	187,2276154
2960	155,5775909	187,1106415	188,2639923	187,2214508	186,1089325	187,1515045
2965	155,5717468	187,0354767	188,1850433	187,1459045	186,0367737	187,075943
2970	155,5665131	186,9609222	188,1066742	187,0708771	185,9651337	187,0009308
2975	155,5621185	186,8869019	188,0288696	186,99646	185,8940582	186,9264832
2980	155,5588989	186,813446	187,9516449	186,9225464	185,8234558	186,8525543
2985	155,556076	186,7403412	187,8750458	186,8492584	185,7533722	186,7791901
2990	155,5554047	186,6693268	187,7989655	186,7764282	185,6838531	186,7063751
2995	155,6052856	186,5973511	187,7233124	186,7040558	185,6147003	186,6339569
3000	155,6001892	186,5258942	187,6482697	186,6322021	185,5460052	186,5620575
3005	155,5950775	186,4543915	187,5749054	186,5605927	185,476181	186,4904633
3010	155,5899048	186,3826599	187,502121	186,4889526	185,4058228	186,4189758
3015	155,5847473	186,3109741	187,4291382	186,4172211	185,3356171	186,3475037
3020	155,5797729	186,2394562	187,3558807	186,3455811	185,2658539	186,2761841
3025	155,5750427	186,1682587	187,2825012	186,2740479	185,1966248	186,2050629
3030	155,570816	186,0974579	187,2091827	186,2028198	185,1278839	186,1342468
3035	155,5657501	186,0270081	187,1359406	186,1318512	185,0596313	186,0637054
3040	155,562439	185,9570465	187,0630341	186,0613556	184,9919281	185,9935913
3045	155,560318	185,8875427	186,9905548	185,9913483	184,9247437	185,9239044
3050	155,5585175	185,8182983	186,9184418	185,9217834	184,8580475	185,85466
3055	155,5540009	185,749588	186,8466339	185,8525848	184,7917328	185,7857513
3060	155,5546417	185,6828156	186,7752991	185,7839355	184,7259674	185,7173615
3065	155,6064301	185,6149902	186,7043304	185,7156372	184,6605682	185,6492767
3070	155,6024628	185,5476074	186,6338348	185,6477966	184,5955963	185,581665
3075	155,5986328	185,4806976	186,563736	185,5803528	184,5310364	185,5144348
3080	155,5950317	185,4141998	186,4941559	185,5133972	184,4669342	185,4476624
3085	155,591507	185,3481445	186,4249573	185,4468689	184,4031982	185,3812866
3090	155,5883331	185,2825165	186,3562622	185,3808289	184,33992	185,3153839
3095	155,5850983	185,2172546	186,2879639	185,3151703	184,2770081	185,2498627

TIME	P	TAVG	THA	THB	TCA	TCB
3100	155,5823212	185,1524811	186,2201691	185,25	184,2145538	185,1847687
3105	155,5793762	185,088028	186,1527252	185,1851654	184,1524353	185,1200409
3110	155,5771027	185,0240631	186,0857849	185,1208038	184,090744	185,0557709
3115	155,5743561	184,9604492	186,0192108	185,056778	184,0294037	184,9918671
3120	155,5718231	184,8972473	185,9529877	184,9931183	183,9684296	184,928299
3125	155,5703735	184,8344879	185,8873444	184,9299622	183,9079132	184,8652496
3130	155,5681	184,7720795	185,821991	184,8671417	183,8477173	184,8025208
3135	155,5660248	184,7100677	185,7570496	184,8047485	183,7878876	184,7401886
3140	155,5657959	184,6485138	185,6926117	184,7428284	183,7284851	184,6783142
3145	155,5641022	184,5872345	185,6285095	184,6811676	183,6694183	184,6167603
3150	155,5626526	184,5264282	185,5647888	184,6199493	183,610733	184,5555725
3155	155,5614319	184,4659424	185,5014648	184,5590973	183,5523682	184,494751
3160	155,5630341	184,4059143	185,4386597	184,498703	183,4944611	184,4344177
3165	155,5621643	184,3461761	185,3761749	184,4386139	183,4368439	184,3743896
3170	155,5614929	184,28685	185,3140259	184,378891	183,3795776	184,3147125
3175	155,5610199	184,2278595	185,252243	184,3195343	183,3226624	184,2554169
3180	155,5607758	184,16922	185,1908417	184,260498	183,2660828	184,1964417
3185	155,5606689	184,1109467	185,1298065	184,2018127	183,2098389	184,1378632
3190	155,5608215	184,0530243	185,0691376	184,1434784	183,1539459	184,0796509
3195	155,5611267	183,9954987	185,0088959	184,0854797	183,0984039	184,0217743
3200	155,5616302	183,9383545	184,9490051	184,0279388	183,0432129	183,9642944
3205	155,5623016	183,8815765	184,8895416	183,9707336	182,9883881	183,9071808
3210	155,5631714	183,8251343	184,8304596	183,9138947	182,9338989	183,8504791
3215	155,5615997	183,7689819	184,7715912	183,8572845	182,8796539	183,7940216
3220	155,5628662	183,7132416	184,7131805	183,8010406	182,8258209	183,7379303
3225	155,5643463	183,6578522	184,6551514	183,7452393	182,7723083	183,682251
3230	155,5659637	183,6028137	184,5975189	183,6897888	182,719162	183,6269379
3235	155,5677643	183,5480957	184,5402222	183,6346588	182,6663208	183,5719452
3240	155,5681305	183,4936981	184,4831696	183,5797729	182,6137543	183,5172424
3245	155,5703125	183,4396973	184,4265747	183,5252533	182,5615692	183,4629059
3250	155,5726776	183,3860321	184,3704071	183,4711914	182,5097198	183,4089508
3255	155,5742188	183,3326874	184,3144684	183,4173584	182,4581451	183,3552704
3260	155,5769043	183,2796326	184,2605286	183,3639221	182,4053192	183,3019409
3265	155,5796204	183,2267151	184,2083588	183,3108215	182,3512421	183,248764
3270	155,5818939	183,1739349	184,1568604	183,2577667	182,2966919	183,1957245
3275	155,5848389	183,1213531	184,1058044	183,2050018	182,2421112	183,1429291
3280	155,5878448	183,0689545	184,0550842	183,15242	182,1876678	183,0903473
3285	155,5906372	183,0167084	184,0044556	183,0998688	182,1333008	183,0378876
3290	155,5938721	182,9646454	183,9540863	183,0475464	182,0791168	182,9856567
3295	155,5970306	182,912796	183,9038544	182,9953461	182,0250854	182,9335785
3300	155,6004791	182,861145	183,8538971	182,9434204	181,9712677	182,8817444
3305	155,6039429	182,8097076	183,8040924	182,8916016	181,9176178	182,8300629
3310	155,6076202	182,7584534	183,7545624	182,8400879	181,8641663	182,7786713
3315	155,5526123	182,707428	183,7052612	182,7887726	181,8109589	182,7274628
3320	155,556366	182,656601	183,6561432	182,7375793	181,7578888	182,6764526

TIME	P	TAVG	THA	THB	TCA	TCB
3325	155,5545197	182,6043854	183,6071167	182,6864777	181,7048645	182,6255188
3330	155,5585022	182,5539703	183,5583954	182,6357117	181,6521759	182,5749054
3335	155,5598145	182,50383	183,5098419	182,5850067	181,5996246	182,5244293
3340	155,5614014	182,4537659	183,4614563	182,5345001	181,547226	182,4741516
3345	155,5657501	182,4039612	183,4134064	182,4843903	181,4951019	182,4240875
3350	155,5685272	182,3539734	183,3653717	182,4350433	181,4430084	182,3733521
3355	155,5728455	182,3039093	183,3173218	182,3860168	181,3909607	182,3223114
3360	155,5761414	182,2536926	183,269104	182,3368225	181,3387756	182,2710724
3365	155,580368	182,203476	183,2208862	182,2875671	181,2865601	182,2199097
3370	155,5840759	182,153244	183,1725769	182,2380981	181,2342682	182,1687469
3375	155,5883484	182,1030426	183,1243439	182,1885529	181,1820068	182,1177826
3380	155,5923157	182,0529327	183,0760956	182,138916	181,1296997	182,0669098
3385	155,5964966	182,0028839	183,0279541	182,0891724	181,0774231	182,0161591
3390	155,6009216	181,9529877	182,980011	182,0395508	181,025238	181,9656525
3395	155,6053162	181,903183	182,9321289	181,9899445	180,9730682	181,9152527
3400	155,5500793	181,8534851	182,8844757	181,9404297	180,9210663	181,8650818
3405	155,5546112	181,8039551	182,8368835	181,8909607	180,8690948	181,8150482
3410	155,553421	181,7528687	182,7894287	181,8414459	180,8171082	181,7650909
3415	155,5552979	181,7037354	182,7420807	181,792038	180,7653046	181,715332
3420	155,5601196	181,6546783	182,6950531	181,7428741	180,7136688	181,6658783
3425	155,5623322	181,6057281	182,6481323	181,6937866	180,6621704	181,6165314
3430	155,5673218	181,5569763	182,6015167	181,6449127	180,6108551	181,5674744
3435	155,5707703	181,5083771	182,5549927	181,5960846	180,5596313	181,5185089
3440	155,5749664	181,4599609	182,5086517	181,5474396	180,5085297	181,4697418
3445	155,5802002	181,4117889	182,4626312	181,4990845	180,4577026	181,4212646
3450	155,5849609	181,3637543	182,4167328	181,4507751	180,4069366	181,3728943
3455	155,5900726	181,3159027	182,3710022	181,4026337	180,3563538	181,324707
3460	155,5956116	181,2682495	182,3255768	181,3547668	180,3059845	181,2767944
3465	155,6010742	181,2207794	182,2803192	181,3070221	180,2557373	181,2290039
3470	155,6067047	181,1734924	182,235199	181,2594147	180,2056274	181,1814117
3475	155,5519257	181,1264038	182,1904144	181,2120972	180,1557617	181,1340942
3480	155,551712	181,0777435	182,1446686	181,1647034	180,1068268	181,0868225
3485	155,5577087	181,0312347	182,0971375	181,1176758	180,0605164	181,0399628
3490	155,5610657	180,9851685	182,0489502	181,0708466	180,0153503	180,993454
3495	155,5646973	180,93927	182,0007477	181,0243073	179,9707947	180,9472046
3500	155,5696106	180,8936768	181,952774	180,9781342	179,926651	180,9013062

Table A.3 shows selected parameter values (set 2): WHPI, QMGA/B, NSGA/B and PRB.

Table A.3 - Selected parameter values for small main steam line break (set 2).

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
0	0	909,1004639	909,1004639	50	50	1,034000039

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
5	0	906,3969116	906,3969116	49,94090652	49,94090652	1,034000039
10	0	906,2554321	906,2554321	49,8967514	49,8967514	1,034000039
15	0	906,2271729	906,2271729	49,94168472	49,94168472	1,034000039
20	0	905,715271	905,715271	49,96588898	49,96588898	1,034000039
25	0	905,4373779	905,4373779	49,96229172	49,96229172	1,034000039
30	0	905,4105225	905,4105225	49,96396255	49,96396255	1,034000039
35	0	905,3397827	905,3397827	49,97511673	49,97511673	1,034000039
40	0	905,2073975	905,2073975	49,98117065	49,98117065	1,034000039
45	0	905,1432495	905,1432495	49,98142242	49,98142242	1,034000039
50	0	905,1340332	905,1340332	49,98346329	49,98346329	1,034000039
55	0	905,1079102	905,1079102	49,98727798	49,98727798	1,034000039
60	0	905,0720825	905,0720825	49,98941803	49,98941803	1,034000039
65	0	905,0583496	905,0583496	49,99034882	49,99034882	1,034000039
70	0	905,0539551	905,0539551	49,99185944	49,99185944	1,034000039
75	0	905,0441895	905,0441895	49,9936409	49,9936409	1,034000039
80	0	905,0358276	905,0358276	49,99487305	49,99487305	1,034000039
85	0	905,0296631	905,0296631	49,99584579	49,99584579	1,034000039
90	0	905,0256348	905,0256348	49,99675751	49,99675751	1,034000039
95	0	905,0253296	905,0253296	49,99764633	49,99764633	1,034000039
100	0	905,0220337	905,0220337	49,99863052	49,99863052	1,034000039
105	0	950,2177734	903,9608154	52,37203217	50,0635643	1,035780311
110	0	974,4869385	901,5115356	51,35887909	49,54073334	1,037559271
115	0	994,2521973	901,9418335	50,59604263	49,15907288	1,039259791
120	0	1008,274414	901,7266846	50,07644272	48,99531555	1,040958762
125	0	1018,050598	900,8619385	49,6061554	48,8636322	1,042656422
130	0	1025,521362	900,2731323	49,1909256	48,77626419	1,044352889
135	0	1031,175171	899,7440186	48,8431778	48,74727249	1,046048045
140	0	1035,394165	899,1430664	48,53826904	48,7488327	1,04774189
145	0	1038,648438	898,5684814	48,26715469	48,77051163	1,049480557
150	0	1041,203125	898,019104	48,02811813	48,8098526	1,05124867
155	0	1043,23584	897,4795532	47,81558228	48,86014175	1,05301559
160	0	1044,906494	896,9707642	47,62656021	48,91778946	1,05478096
165	0	1046,301514	896,4788818	47,46014786	48,9817543	1,0565449
170	0	1047,483887	895,9945679	47,31403351	49,04944992	1,058307648
175	0	1048,511963	895,5223389	47,18621826	49,11886597	1,060068965
180	0	1049,425903	895,0652466	47,07572556	49,18924332	1,061897516
185	0	1050,25	894,6211548	46,98167419	49,25995636	1,063732147

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
190	0	1051	894,1865845	46,90296936	49,33031845	1,065565467
195	0	1051,692749	893,7648315	46,83872604	49,39974976	1,067397118
200	0	1052,338257	893,3550415	46,78807831	49,4679451	1,069227219
205	0	1052,93811	892,9534912	46,75040817	49,53470993	1,071055889
210	0	1053,505615	892,5667114	46,72479248	49,59970093	1,072882891
215	0	1054,036011	892,1885986	46,71072388	49,66294861	1,074708581
220	0	1054,533691	891,8179321	46,70728302	49,72398376	1,076532602
225	0	1055,006714	891,4639282	46,71372986	49,78276825	1,078355193
230	0	1055,45105	891,1192627	46,72979355	49,8396225	1,080176234
235	0	1055,866455	890,7837524	46,75450897	49,8940773	1,081995726
240	0	1056,255371	890,4577637	46,7871933	49,94595337	1,083813906
245	0	1056,625366	890,1491699	46,8273735	49,99543381	1,085630417
250	0	1056,967651	889,8480835	46,87472153	50,04280472	1,087445617
255	0	1057,285278	889,5581055	46,92814636	50,08742523	1,089259624
260	0	1057,580688	889,2792358	46,98733521	50,12957382	1,091052532
265	0	1057,852661	889,0118408	47,05169296	50,16917801	1,092933059
270	0	1058,107788	888,7619019	47,12075424	50,20631027	1,094812512
275	0	1058,334717	888,5153198	47,19419479	50,24121094	1,096691132
280	0	1058,548584	888,2876587	47,27120972	50,27345276	1,098568559
285	0	1058,737061	888,0688477	47,35164261	50,30352402	1,100444913
290	0	1058,906738	887,8612061	47,43465805	50,33092499	1,102319717
295	0	1059,05835	887,6654663	47,52013779	50,35606003	1,104193211
300	0	1059,191528	887,4800415	47,60757065	50,37888336	1,106154561
305	0	1059,30603	887,3068848	47,69655228	50,39939499	1,108124375
310	0	1059,409058	887,1491089	47,78682327	50,41777039	1,110092044
315	0	1059,488281	886,9963989	47,87807083	50,43409729	1,112059593
320	0	1059,558472	886,8591919	47,96984482	50,44832993	1,114025354
325	0	1059,611084	886,7315063	48,06181717	50,46045685	1,115989923
330	0	1059,646729	886,6130371	48,15391922	50,4707756	1,117953062
335	0	1059,673706	886,5082397	48,24551392	50,47903442	1,119915128
340	0	1059,681763	886,4086914	48,33675003	50,48566818	1,121876001
345	0	1059,682617	886,3237915	48,42696381	50,4902916	1,123834848
350	0	1059,670288	886,2470093	48,51643372	50,49357986	1,12579298
355	0	1059,644043	886,1778564	48,60444641	50,49494934	1,127750039
360	0	1059,612549	886,1228027	48,691185	50,49494934	1,129705548
365	0	1059,563721	886,0690308	48,7764473	50,49355316	1,131727934
370	0	1059,513184	886,0316772	48,85978699	50,49061966	1,133777857

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
375	0	1059,449341	885,998291	48,94152069	50,48667908	1,135826826
380	0	1059,37854	885,9741821	49,02103043	50,48121643	1,137874007
385	0	1059,302856	885,9599609	49,09864044	50,47486115	1,139919758
390	0	1059,213135	885,9456177	49,17399216	50,46728134	1,141964436
395	0	1059,12439	885,9473267	49,24702454	50,45875549	1,14409411
400	0	1059,022583	885,9476929	49,3178978	50,44945526	1,146232247
405	0	1058,922485	885,961853	49,38615417	50,43909073	1,148368955
410	0	1058,810181	885,9755249	49,45214844	50,42818069	1,15050447
415	0	1058,701294	886,0018311	49,51548767	50,41642761	1,152638078
420	0	1058,579346	886,0264282	49,57644272	50,40412521	1,154769778
425	0	1058,463257	886,0634766	49,63476563	50,39121628	1,156900525
430	0	1058,335693	886,0966187	49,69058228	50,37783813	1,159029245
435	0	1058,214233	886,1439209	49,74380112	50,36395645	1,161156893
440	0	1058,081177	886,1871948	49,79461288	50,34988403	1,163282514
445	0	1057,952271	886,2396851	49,84263611	50,33525467	1,1654073
450	0	1057,818237	886,2925415	49,8884201	50,32064819	1,167529583
455	0	1057,682495	886,3475342	49,93147659	50,30560303	1,169649959
460	0	1057,55127	886,4118042	49,97224808	50,29059982	1,1717695
465	0	1057,414551	886,4726563	50,01057434	50,27547073	1,173886895
470	0	1057,277954	886,5380859	50,04636383	50,26013184	1,176002502
475	0	1057,169678	886,6347656	50,07602692	50,24055481	1,178116798
480	0	1057,120239	886,7962036	50,10133743	50,21884918	1,180287838
485	0	1057,10144	886,9960327	50,12746429	50,20077896	1,182518482
490	0	1057,030518	887,1478882	50,15531921	50,18699265	1,184747458
495	0	1056,921265	887,2595215	50,1803627	50,17234802	1,186975121
500	0	1056,818726	887,3738403	50,2026825	50,15710068	1,189200997
505	0	1056,720947	887,489502	50,2241478	50,14333725	1,19142437
510	0	1056,609863	887,5872803	50,24312973	50,12913513	1,193693757
515	0	1056,521118	887,7037964	50,2592392	50,11416626	1,196031928
520	0	1056,447876	887,8328857	50,27351761	50,09948349	1,198368788
525	0	1056,38208	887,9662476	50,28606796	50,08510208	1,200703859
530	0	1056,329346	888,1108398	50,29771042	50,07197189	1,203037262
535	0	1056,266235	888,2408447	50,30722046	50,05851746	1,205369353
540	0	1056,210083	888,3737183	50,31649017	50,0468483	1,207699776
545	0	1056,142456	888,4904785	50,32434082	50,03559494	1,210029006
550	0	1056,083252	888,6075439	50,33052444	50,02446747	1,212356091
555	0	1056,018921	888,7142944	50,3365593	50,01501846	1,214681506

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
560	0	1055,94751	888,8063354	50,34177017	50,00645447	1,217006326
565	0	1055,872925	888,8881836	50,34573746	49,9982605	1,21932888
570	0	1055,79834	888,9627686	50,34849167	49,99043655	1,221649647
575	0	1055,724854	889,0311279	50,35011292	49,98303223	1,223968983
580	0	1055,656738	889,0979614	50,3507843	49,97616959	1,226287127
585	0	1055,589844	889,1592407	50,35052872	49,96977234	1,228603482
590	0	1055,52478	889,2172241	50,3493309	49,96380997	1,230917931
595	0	1055,461304	889,2706909	50,34722519	49,95822525	1,233230829
600	0	1055,401001	889,3217773	50,34430313	49,95306015	1,235543013
605	0	1055,343994	889,3713989	50,34059143	49,94828033	1,237910628
610	0	1055,28894	889,4174805	50,33614349	49,94387054	1,240334511
615	0	1055,236084	889,4611206	50,33103561	49,93984985	1,24275744
620	0	1055,188354	889,5043335	50,32529068	49,93615723	1,245178342
625	0	1055,140869	889,5449829	50,31901169	49,93286514	1,247666001
630	0	1055,097412	889,5840454	50,31216049	49,92984009	1,250198126
635	0	1055,053833	889,6187134	50,30498505	49,92728043	1,25272882
640	0	1055,016235	889,6558228	50,2972641	49,92489624	1,255257368
645	0	1054,976318	889,6862793	50,28927994	49,92294693	1,25778389
650	0	1054,943604	889,7203979	50,28084183	49,92118073	1,260308385
655	0	1054,908203	889,7489014	50,27229691	49,9198494	1,262831092
660	0	1054,87793	889,777832	50,26337814	49,91863632	1,265340686
665	0	1054,848267	889,8032837	50,25437164	49,91783142	1,267858744
670	0	1054,822754	889,8302002	50,24513245	49,91719055	1,270374775
675	0	1054,796631	889,8504028	50,23593521	49,91695404	1,272889853
680	0	1054,772583	889,8703613	50,22649002	49,91675568	1,275403142
685	0	1054,75354	889,8926392	50,21704865	49,91688156	1,277914882
690	0	1054,732056	889,9103394	50,20766068	49,91726685	1,280424356
695	0	1054,713135	889,928833	50,19812393	49,91771698	1,282933474
700	0	1054,697876	889,9477539	50,18862915	49,91834641	1,285454392
705	0	1054,680786	889,9620972	50,1792984	49,91924286	1,288100243
710	0	1054,668457	889,9780273	50,1699791	49,92025375	1,290743828
715	0	1054,654053	889,989502	50,16086197	49,92148972	1,293385029
720	0	1054,643555	890,0025024	50,15178299	49,92279053	1,296024561
725	0	1054,631714	890,0130615	50,14291	49,92432404	1,298732162
730	16,98877907	926,5452271	766,5947266	50,49014282	50,31453705	1,30095315
735	15,30044365	973,7143555	807,4613037	46,10778427	46,75912857	1,302618623
740	15,80121517	975,4977417	805,8846436	41,86647797	43,16516113	1,304284215

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
745	16,54241371	980,0793457	807,3064575	37,66225815	39,60426331	1,30594945
750	16,50418091	988,3859863	813,8289185	33,42255402	36,04423904	1,307615042
755	16,45345306	992,472168	817,4866943	29,23876953	32,52374268	1,30915451
760	16,49755096	996,0321655	820,9035034	25,20112228	29,11691284	1,310680628
765	16,53139877	1000,475037	826,5971069	21,2133503	25,77834702	1,312206388
770	16,56008911	1004,660156	833,3189697	17,18348503	22,42673683	1,313677669
775	14,61918831	420,407074	339,0929871	0	3,115781784	1,31526041
780	16,1769104	355,303772	264,3288879	0	3,247980356	1,31716311
785	20,44085884	286,8808289	197,7293701	0	3,305538893	1,319301128
790	23,92557907	231,7626343	153,7579193	0	3,503602505	1,321521878
795	26,44967079	190,620285	138,2134552	0	4,244784355	1,323770523
800	28,71177101	163,8302612	122,8111038	0	4,692508221	1,326130986
805	30,54550743	144,8959351	108,2822037	0	4,735607624	1,328614354
810	32,03795242	130,0965729	96,48352051	0	4,526798725	1,330974817
815	33,10229874	46,4024086	90,50311279	0	4,307281971	1,333279371
820	33,42025757	49,18835449	90,62908173	0	4,114048481	1,335499644
825	33,74596786	51,03590393	89,00388336	0	3,814602852	1,337718844
830	34,07517624	52,47901917	86,45787811	0	3,492223978	1,339938521
835	34,39964676	53,44480133	83,25323486	0	3,172022104	1,341977358
840	34,70573807	54,07781982	79,63697052	0	2,869087219	1,34391892
845	34,98891068	54,50130081	78,40139771	0	2,756378412	1,345860362
850	35,26919174	54,76141357	77,82847595	0	2,644150734	1,347801924
855	35,55021667	55,07701874	77,3923111	0	2,510305643	1,349743485
860	35,83259201	55,21180344	76,94642639	0	2,356788158	1,351685047
865	36,11358261	55,18719101	76,53007507	0	2,190100193	1,353626609
870	36,39286423	55,0789566	76,22038269	0	2,015345335	1,355470657
875	36,67450333	54,94699097	76,18306732	0	1,83812499	1,357133031
880	36,95087051	54,77890778	76,24825287	0	1,660575271	1,358795404
885	37,22037506	54,58832169	76,25499725	0	1,483323932	1,360457897
890	37,48693466	54,36101151	76,21807098	0	1,30676198	1,362120271
895	37,75516891	54,1298027	76,19696808	0	1,131328821	1,363782525
900	38,02181625	53,90174866	76,19966125	0	0,957470477	1,365445137
905	38,28675079	53,67596054	76,21829224	0	0,785570621	1,367107391
910	38,55001068	53,46151352	76,24168396	0	0,615882695	1,368769884
915	38,81132507	53,23896027	76,26303101	0	0,448641807	1,370432377
920	39,07045746	53,01843262	76,28320313	0	0,284007847	1,372094631
925	39,32720947	52,79995346	76,2972641	0	0,122101359	1,373715878

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
930	39,58106613	52,57359695	76,71482086	0	0	1,375115752
935	39,828125	52,26357651	76,70973206	0	0	1,376502514
940	40,06463623	51,85375214	76,32363892	0	0	1,377889872
945	40,29231262	51,37338257	75,71362305	0	0	1,379276872
950	40,51144409	50,88111115	75,15632629	0	0	1,380662918
955	40,72061539	50,40670776	74,72891235	0	0	1,382049322
960	40,92110443	49,95437622	74,39493561	0	0	1,383435369
965	41,11396027	49,62740707	74,13893127	0	0	1,384821415
970	41,30195236	49,62319183	73,915802	0	0	1,386207461
975	41,4873848	49,61946869	73,7019043	0	0	1,387593508
980	41,67435074	49,60256577	73,44444275	0	0	1,388979554
985	41,85859299	49,56469727	73,09467316	0	0	1,390365958
990	42,02848434	49,49108124	72,66486359	0	0	1,391753078
995	42,18512344	49,39605331	72,17311096	0	0	1,392932773
1000	42,33531189	49,29299164	71,66313171	0	0	1,39404285
1005	42,48003006	49,21183395	71,22014618	0	0	1,395153284
1010	42,6185112	49,14870453	70,82588959	0	0	1,396370411
1015	42,75128937	49,09643555	70,413414	0	0	1,397603631
1020	42,87758636	49,03586578	69,78739929	0	0	1,398766994
1025	42,99537277	48,95603943	69,03507996	0	0	1,399826288
1030	43,10338974	48,8745079	68,23483276	0	0	1,400885701
1035	43,20139313	48,80325699	67,50595093	0	0	1,401945233
1040	43,2905159	48,75501251	67,33143616	0	0	1,403004885
1045	43,37879944	48,66415787	68,05039215	0	0	1,404064536
1050	43,47039413	48,4852562	68,50003815	0	0	1,405123949
1055	43,5620842	48,24629211	68,76012421	0	0	1,406183481
1060	43,65145493	47,96927261	68,88561249	0	0	1,407243133
1065	43,73695374	47,67577744	68,91583252	0	0	1,408302546
1070	43,81751633	47,3635025	68,87712097	0	0	1,409362078
1075	43,89248657	47,07028961	68,81034088	0	0	1,410421729
1080	43,96178436	46,79640961	68,73027802	0	0	1,411481142
1085	44,02550125	46,53951263	68,64347839	0	0	1,412544012
1090	44,09288406	46,2586441	68,44335938	0	0	1,413606882
1095	44,14509583	45,92025757	68,05441284	0	0	1,414669752
1100	44,1724472	45,52633667	67,50482178	0	0	1,415733337
1105	44,18440628	45,08074951	66,82491302	0	0	1,416708112
1110	44,18293381	44,62084579	66,1359787	0	0	1,417593956

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
1115	44,16969299	44,21914291	65,62057495	0	0	1,418479562
1120	44,14692307	55,83862305	45,60581207	0	0	1,419276476
1125	44,05189133	59,98058319	38,31499481	0	0	1,419985175
1130	43,92385864	63,59166336	32,54447174	0	0	1,420694113
1135	43,77906418	66,68225861	28,02272415	0	0	1,421402812
1140	43,62271881	68,82732391	24,47078514	0	0	1,42211175
1145	43,45506287	70,25306702	21,69339752	0	0	1,422820449
1150	43,27730179	71,4019928	19,52900505	0	0	1,423529148
1155	43,09272385	72,42989349	17,82822609	0	0	1,424168229
1160	42,90408325	73,33461761	16,45014	0	0	1,424699783
1165	42,71300888	74,11965179	15,30558395	0	0	1,425089955
1170	42,52041626	74,76712799	14,33463097	0	0	1,425444245
1175	42,32663345	75,31069183	13,49513626	0	0	1,425798893
1180	42,13192368	75,75832367	12,76072121	0	0	1,426153541
1185	41,93641663	76,13423157	12,11060047	0	0	1,426509976
1190	41,74026108	76,43672943	11,52757072	0	0	1,426866174
1195	41,54347229	76,66829681	11,00933647	0	0	1,42722249
1200	41,34646225	77,22782135	10,58887291	0	0	1,427578688
1205	41,1533432	77,93325806	10,22790146	0	0	1,427934885
1210	40,96487427	78,47704315	9,918539047	0	0	1,428291202
1215	40,78003311	78,82753754	9,659207344	0	0	1,428647399
1220	40,59760666	78,95011139	9,451770782	0	0	1,42875433
1225	40,41623688	78,91790771	9,295655251	0	0	1,42875433
1230	40,23527908	78,78334045	9,186991692	0	0	1,42875433
1235	40,05441284	78,57853699	9,120043755	0	0	1,42875433
1240	39,8735466	78,32244873	9,088934898	0	0	1,42875433
1245	39,69268036	78,03833771	9,087645531	0	0	1,42875433
1250	39,51187515	77,76457214	9,110152245	0	0	1,42875433
1255	39,33159637	77,50147247	9,149718285	0	0	1,42875433
1260	39,15214157	77,24716187	9,201900482	0	0	1,42875433
1265	38,97380829	77	9,249620438	0	0,155324146	1,42875433
1270	38,79668427	76,75921631	9,288982391	0	0,338078529	1,42875433
1275	38,62085342	76,52389526	9,322976112	0	0,519875407	1,42875433
1280	38,44646835	76,29335022	9,352197647	0	0,700700998	1,42875433
1285	38,27355576	76,06695557	9,377090454	0	0,880575955	1,42875433
1290	38,10229111	75,84411621	9,398241043	0	1,059472799	1,42875433
1295	37,93276596	75,62436676	9,415807724	0	1,237398386	1,42875433

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
1300	37,76509476	75,40725708	9,429946899	0	1,414352894	1,42875433
1305	37,59936905	75,19255066	9,441096306	0	1,59032917	1,42875433
1310	37,4357338	74,97987366	9,449832916	0	1,765320659	1,42875433
1315	37,27431107	74,76905823	9,456028938	0	1,939320326	1,42875433
1320	37,11518097	74,55989075	9,46025753	0	2,112321377	1,42875433
1325	36,95838547	74,35242462	9,422154427	0	2,284666061	1,42875433
1330	36,80364609	74,14782715	9,311270714	0	2,456641197	1,42875433
1335	36,65046692	73,94715881	9,151247025	0	2,62811017	1,42875433
1340	36,49847031	73,7510376	8,959141731	0	2,798949957	1,42875433
1345	36,3471489	73,55954742	8,751224518	0	2,969064713	1,42875433
1350	36,19650269	73,37240601	8,535413742	0	3,138379335	1,42875433
1355	36,04656601	73,18922424	8,31635952	0	3,306866407	1,42875433
1360	35,89742661	73,00984955	8,09924984	0	3,474477768	1,42875433
1365	35,74931335	72,83338928	7,9183321	0	3,640885592	1,42875433
1370	35,60273743	72,65916443	7,778082371	0	3,806007385	1,42875433
1375	35,45848465	72,64590454	7,668595791	0	3,969870806	1,42875433
1380	35,3184166	72,65634918	7,576392174	0	4,132509708	1,42875433
1385	35,18288422	72,64058685	7,499742031	0	4,293931484	1,42875433
1390	35,05194855	72,60257721	7,436502457	0	4,45414257	1,428723574
1395	34,92569351	72,54605865	7,385380268	0	4,613156796	1,428415418
1400	34,8042717	72,47373199	7,344252586	0	4,770967007	1,428107381
1405	34,68776703	72,38792419	7,311837673	0	4,927587509	1,427799225
1410	34,57636261	72,29089355	7,287000179	0	5,083017349	1,427491188
1415	34,47010803	72,18449402	7,26874733	0	5,237271309	1,427183151
1420	34,36922073	72,07025909	7,254022121	0	5,390355587	1,426875114
1425	34,27377701	71,94967651	7,228193283	0	5,54245472	1,426567197
1430	34,1837883	71,82391357	7,207967281	0	5,693363667	1,426258922
1435	34,0995369	71,6869278	7,192772388	0	5,843082905	1,425950766
1440	33,93154526	71,51191711	7,151146412	0	5,991611958	1,425642848
1445	33,60957718	71,30176544	7,064790726	0	6,256482601	1,425334692
1450	33,27214813	71,08417511	7,004342079	0	6,412713051	1,425027013
1455	32,92193222	70,86178589	6,960456848	0	6,568191051	1,424718976
1460	32,55875397	70,63666534	6,929933071	0	6,722957611	1,424410939
1465	32,1824379	70,41033936	6,920366287	0	6,87693119	1,424102783
1470	31,79281044	70,18380737	6,924597263	0	7,030179501	1,423794508
1475	31,38968849	69,95831299	6,933863163	0	7,182757378	1,42348659
1480	30,97284126	69,73614502	6,947328568	0	7,334720135	1,423178554

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
1485	30,70725632	69,51463318	6,955746174	0	7,48602581	1,422870517
1490	30,4969635	69,29917908	6,971340656	0	7,636715889	1,422562599
1495	30,2869339	69,08666992	6,985414982	0	7,786790848	1,422254324
1500	30,07761002	68,87159729	6,984579086	0	7,93625021	1,421946049
1505	29,86702156	68,63983154	7,416011333	0	8,085298538	1,421638012
1510	29,6568737	68,38534546	7,789181709	0	8,234347343	1,421330094
1515	29,44666862	68,11188507	8,033226967	0	8,383218765	1,421022415
1520	29,23572731	67,81034851	8,174192429	0	8,531774521	1,420714378
1525	29,02487183	67,50972748	8,232756615	0	8,679865837	1,42040658
1530	28,81507683	67,20492554	8,225059509	0	8,827410698	1,420098424
1535	28,606287	66,89627075	8,157922745	0	8,974352837	1,419790149
1540	28,39837837	66,58470154	8,009283066	0	9,120883942	1,419482231
1545	28,18628693	66,28849792	7,82884407	0	9,266978264	1,419174194
1550	27,96718216	66,01713562	7,648423195	0	9,41258049	1,4188658
1555	27,74604988	65,76905823	7,471492767	0	9,557703018	1,418557882
1560	27,52347374	65,53023529	7,298709393	0	9,702319145	1,418249726
1565	27,29965782	65,32220459	7,131126404	0	9,846429825	1,417941451
1570	27,07486725	65,13006592	6,971656799	0	9,989994049	1,417633533
1575	26,84931564	64,95185852	6,819341183	0	10,13302326	1,417325497
1580	26,62320137	64,78561401	6,672959328	0	10,27550602	1,41701746
1585	26,39670753	64,63006592	6,531960011	0	10,41744232	1,416709542
1590	26,16988754	64,48378754	6,395794392	0	10,55885792	1,416401625
1595	25,94291878	64,3130188	6,268286228	0	10,6996851	1,416093588
1600	25,71580505	64,159935	6,16766119	0	10,83981514	1,415785313
1605	25,53820801	64,01100159	6,08088541	0	10,97922039	1,415477037
1610	25,35987473	63,86802673	6,011073589	0	11,11795521	1,41516912
1615	25,18224907	63,73088455	5,956717491	0	11,25601959	1,414860606
1620	25,00544739	63,59849548	5,914213181	0	11,39345455	1,414552689
1625	24,82952881	63,47006226	5,881248474	0	11,53024673	1,414244652
1630	24,65461159	63,34498596	5,855490685	0	11,66643715	1,413936377
1635	24,48084641	63,22266769	5,835178375	0	11,8020525	1,41362834
1640	24,30834389	63,09145737	5,819244862	0	11,93705273	1,413320422
1645	24,13625526	62,97367477	5,80701828	0	12,0715065	1,413012147
1650	23,9647274	62,85752106	5,797280788	0	12,20535755	1,41270411
1655	23,793787	62,74272156	5,789300919	0	12,33868885	1,412396193
1660	23,62343788	62,62923431	5,782520771	0	12,47143173	1,412087917
1665	23,45373535	62,51667023	5,776414394	0	12,60362816	1,411779881

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
1670	23,27955437	62,40508652	5,77110815	0	12,73530388	1,411471963
1675	23,06581306	62,29837036	5,774925709	0	12,86640549	1,411163926
1680	22,85307312	62,19253159	5,778610229	0	12,997015	1,41085577
1685	22,6403923	62,07659531	5,781512737	0	13,12710381	1,410547733
1690	22,42771339	61,9728241	5,783896923	0	13,25668716	1,410239697
1695	22,21523857	61,87953186	5,785245419	0	13,38576508	1,40993154
1700	22,00303078	61,79826736	5,784787178	0	13,51429462	1,409623384
1705	21,79211617	61,71416473	5,7826581	0	13,64229107	1,409315467
1710	21,58264732	61,62768555	5,779119968	0	13,76979542	1,409007311
1715	21,37453079	61,53907013	5,77443409	0	13,89680672	1,408699274
1720	21,16774368	61,43779755	5,768732548	0	14,02333927	1,408391356
1725	20,96219063	61,34731293	5,762663841	0	14,14937973	1,408083081
1730	20,75793648	61,25551224	5,755843639	0	14,27490044	1,407774925
1735	20,5549469	61,1626091	5,748274326	0	14,39992809	1,407466769
1740	20,3532238	61,12112427	5,739957809	0	14,52443695	1,407158613
1745	20,15329933	61,12213516	5,72753334	0	14,64847946	1,406850576
1750	20,07965469	61,1003418	5,691755772	0	14,77201653	1,406542659
1755	20,0279007	61,06241989	5,644141674	0	14,89502048	1,406234384
1760	19,97605515	61,01618195	5,598549366	0	15,01749039	1,405926466
1765	19,92412376	60,96280289	5,554719448	0	15,13941383	1,405618548
1770	19,87198257	60,90346146	5,512553215	0	15,26082993	1,405310631
1775	19,81969643	60,83912659	5,47197485	0	15,38172722	1,405002475
1780	19,76726341	60,7706337	5,433014393	0	15,50210476	1,404694438
1785	19,71444702	60,6986351	5,395539284	0	15,62197495	1,404386163
1790	19,65945053	60,62324905	5,358402252	0	15,74134064	1,404077888
1795	19,60162544	60,5428772	5,316950321	0	15,86021233	1,403769851
1800	19,54312325	60,45227432	5,259595394	0	15,97855186	1,403461933
1805	19,48426819	60,34211731	5,362158298	0	16,09642601	1,403153777
1810	19,42638588	60,23058701	5,532378197	0	16,21412086	1,40284574
1815	19,37050438	60,10790634	5,642937183	0	16,33157158	1,402537704
1820	19,3170414	59,97626114	5,705556393	0	16,44870567	1,402229548
1825	19,26572609	59,83734131	5,729619503	0	16,56548691	1,401921272
1830	19,2166214	59,69260788	5,722546101	0	16,6818409	1,401613235
1835	19,1694603	59,54294586	5,69009161	0	16,79776001	1,401305079
1840	19,12400818	59,38932419	5,637234211	0	16,91318512	1,400997043
1845	19,08011818	59,23218155	5,567460537	0	17,02810287	1,400689006
1850	19,03713799	59,07476425	5,489529133	0	17,14248848	1,40038085

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
1855	18,99239349	58,92543793	5,422034264	0	17,25635529	1,400072813
1860	18,94576263	58,78358459	5,363817215	0	17,36971474	1,399765015
1865	18,8976593	58,6477623	5,312598705	0	17,48258209	1,399457097
1870	18,84979248	58,51729965	5,267398357	0	17,59495735	1,399148822
1875	18,80274773	58,3915863	5,227371216	0	17,70686722	1,398840785
1880	18,75655937	58,2699852	5,191668034	0	17,81831169	1,398532748
1885	18,71128464	58,15184402	5,159278393	0	17,92931747	1,398224711
1890	18,66689301	58,0367012	5,11936903	0	18,03996849	1,397916436
1895	18,62329483	57,92449951	5,063261032	0	18,15034676	1,39760828
1900	18,58040619	57,81526566	4,995140553	0	18,26042366	1,397300124
1905	18,53813362	57,70869064	4,91806078	0	18,3701992	1,396992087
1910	18,49642372	57,60497284	4,835436344	0	18,47963333	1,396684051
1915	18,45524406	57,50349808	4,747652531	0	18,58872414	1,396376014
1920	18,4145031	57,40451431	4,657324791	0	18,69744682	1,396067977
1925	18,37426376	57,30765915	4,56482935	0	18,80582809	1,39575994
1930	18,33440971	57,21266556	4,471406937	0	18,91382599	1,395451784
1935	18,29505348	57,11931992	4,377482414	0	19,02144051	1,395188689
1940	18,25608444	57,02747726	4,286527157	0	19,12865829	1,394946098
1945	18,21761322	56,93695831	4,198705673	0	19,23547935	1,394703269
1950	18,1795826	56,84756851	4,113517284	0	19,34187508	1,394460559
1955	18,14202499	56,75902557	4,030831337	0	19,44788933	1,39421773
1960	18,10496902	56,67137146	3,950517416	0	19,55348015	1,393975019
1965	18,06838226	56,58441162	3,872200489	0	19,65867233	1,39373219
1970	18,03229713	56,49816132	3,795936823	0	19,76348305	1,393489718
1975	17,99671364	56,41248322	3,721598387	0	19,86788177	1,393246889
1980	17,96159935	56,32735825	3,649238825	0	19,97189903	1,393004417
1985	17,9269886	56,24275589	3,578608036	0	20,07550621	1,392761707
1990	17,89287567	56,15845871	3,51433897	0	20,1786747	1,392518878
1995	17,85932541	56,0743103	3,460312843	0	20,28136444	1,392276168
2000	17,82636261	55,99029922	3,415039063	0	20,38357544	1,392033458
2005	17,79398918	55,90605545	3,376424789	0	20,48532104	1,391790748
2010	17,76226425	55,82162094	3,343790293	0	20,58662987	1,391548157
2015	17,73124504	55,73670578	3,315646648	0	20,6875	1,391305566
2020	17,70087624	55,65179443	3,291805744	0	20,78793335	1,39094162
2025	17,67118263	55,56637573	3,270801544	0	20,88794136	1,390529037
2030	17,64213753	55,48101425	3,25274682	0	20,98752785	1,390092254
2035	17,61377144	55,39524078	3,236666679	0	21,08670044	1,389655471

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
2040	17,58605194	55,30937958	3,222432375	0	21,18546486	1,389194489
2045	17,55897903	55,22328949	3,209557295	0	21,2838192	1,388709068
2050	17,53249741	55,13706589	3,197916746	0	21,3817749	1,388223886
2055	17,50666428	55,04920578	3,187386513	0	21,47934914	1,387762785
2060	17,48121262	54,95936584	3,177482605	0	21,57651329	1,387277365
2065	17,45558548	54,85860825	3,168392897	0	21,67328072	1,386792183
2070	17,42957497	54,76810837	3,107446194	0	21,77025223	1,386306882
2075	17,40297508	54,67830276	3,034481049	0	21,86701965	1,385821581
2080	17,37572861	54,58918381	2,972451687	0	21,96333504	1,385336399
2085	17,34791946	54,50046539	2,919289589	0	22,05918503	1,384851098
2090	17,31964111	54,41205978	2,873653173	0	22,15461159	1,384365916
2095	17,29092026	54,32375717	2,834204674	0	22,24963951	1,383880496
2100	17,26184654	54,23538208	2,799612761	0	22,34424591	1,383395195
2105	17,22372818	54,19480896	2,852015257	0	22,43846893	1,382910013
2110	17,17600822	54,17389679	2,941856861	0	22,53245735	1,382424712
2115	17,12931824	54,14076233	3,012868404	0	22,62620163	1,381939411
2120	17,08348274	54,09831619	3,068868637	0	22,71968651	1,381454229
2125	17,03838348	54,04805756	3,112039089	0	22,81286812	1,380968809
2130	16,99381638	53,99243546	3,144079208	0	22,90579224	1,380483627
2135	16,94971848	53,93225479	3,166512966	0	22,9984417	1,379998326
2140	16,90594482	53,86867905	3,182551146	0	23,09074783	1,379513025
2145	16,86240768	53,80242157	3,1933465	0	23,18275452	1,379027843
2150	16,81910515	53,73442459	3,200336456	0	23,27443314	1,378542542
2155	16,77586365	53,66493225	3,203884602	0	23,36578178	1,378057122
2160	16,73285484	53,59439468	3,204592943	0	23,45681763	1,37757194
2165	16,68984795	53,52321243	3,202772856	0	23,54751205	1,377086639
2170	16,64684105	53,45146942	3,199002266	0	23,63788986	1,376601458
2175	16,60383224	53,37974167	3,193708658	0	23,72793961	1,376116157
2180	16,56082535	53,30820847	3,18701458	0	23,81764793	1,375630856
2185	16,51781845	53,23703384	3,179276466	0	23,9070282	1,375145674
2190	16,48143768	53,1267395	3,106351852	0	23,9960804	1,374660254
2195	16,45572281	126,4656219	2,987432003	0	24,08465385	1,374175072
2200	16,7978363	103,1112518	0,428409874	0	24,17029953	1,373883843
2205	17,07558823	86,60719299	-1,05789482	0	24,25248337	1,373641253
2210	17,22953224	75,78140259	-1,76070261	0	24,33275414	1,373398781
2215	17,30691528	68,7897644	-1,99813628	0	24,41202354	1,373156071
2220	17,33678436	64,27010345	-1,97082853	0	24,49085808	1,372913361

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
2225	17,33781624	61,33108521	-1,80276620	0	24,56952667	1,372670889
2230	17,32241058	59,40813828	-1,47195756	0	24,64821053	1,37242806
2235	17,29816628	58,11485291	-0,93196231	0	24,72730255	1,372185588
2240	17,27012253	57,21044922	-0,45639553	0	24,80686188	1,371942997
2245	17,24043083	56,55367661	-0,04931019	0	24,88680267	1,371700406
2250	17,2102375	56,05505371	0,291780382	0	24,96700478	1,371457696
2255	17,18021965	55,6586647	0,572151423	0	25,04739761	1,371215105
2260	17,14993858	55,33891678	0,805436611	0	25,12788582	1,370972514
2265	17,11836052	55,07974625	1,00464654	0	25,20841408	1,370729804
2270	17,08563232	54,86037827	1,173461556	0	25,28894424	1,370487213
2275	17,05184555	54,66801071	1,315783858	0	25,36943245	1,370244622
2280	17,0170269	54,49401093	1,435386658	0	25,44983864	1,370002151
2285	16,9812088	54,33320999	1,535684228	0	25,53013611	1,369759321
2290	16,94435692	54,18234253	1,620079637	0	25,6102829	1,369516611
2295	16,90724182	54,03846359	1,690693259	0	25,69029236	1,369273782
2300	16,86983109	53,89968491	1,749522924	0	25,77012444	1,369031072
2305	16,83227348	53,76533508	1,79879117	0	25,84976578	1,368788123
2310	16,79450989	53,63419724	1,84013617	0	25,92920113	1,368545532
2315	16,75645065	53,49871063	1,874960303	0	26,00843048	1,368302941
2320	16,71803856	53,35895157	1,904662132	0	26,08742714	1,36806035
2325	16,67927361	53,21732712	1,930289149	0	26,16621971	1,36781764
2330	16,64006615	53,07522202	1,95288682	0	26,24476624	1,367575049
2335	16,60041618	52,93365479	1,972692132	0	26,32309341	1,367332458
2340	16,56032372	52,79332733	1,990514994	0	26,4011879	1,36708951
2345	16,51979256	52,6542244	2,006705284	0	26,47903633	1,366847038
2350	16,47878838	52,51633072	2,021151543	0	26,55665207	1,366604328
2355	16,52877617	52,36710358	2,025727034	0	26,63403511	1,366361737
2360	16,4987011	52,23540497	2,03876543	0	26,71115875	1,366119027
2365	16,45551682	52,10404968	2,050641298	0	26,7880497	1,365876555
2370	16,51502037	51,96203613	2,053016663	0	26,86468124	1,365633845
2375	16,47101021	51,83511734	2,063724518	0	26,94108009	1,365391254
2380	16,52589035	51,69635773	2,065290689	0	27,01723289	1,365148664
2385	16,48382568	51,57247543	2,074606657	0	27,09313774	1,364906073
2390	16,52500534	51,43572617	2,074571371	0	27,16882515	1,364663363
2395	16,49392891	51,31726837	2,083186626	0	27,2442379	1,364420533
2400	16,44526482	51,20083618	2,091675758	0	27,31943321	1,364178061
2405	16,50144005	51,07233429	2,089814186	0	27,39436913	1,363935232

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
2410	16,45148087	50,96006012	2,097494125	0	27,46907043	1,36369276
2415	16,50644684	50,8350563	2,094840765	0	27,5435257	1,36345005
2420	16,45524979	50,72591019	2,101715326	0	27,61773682	1,363207459
2425	16,50886345	50,66132355	2,098159552	0	27,69171333	1,362964749
2430	16,45734406	50,75221634	2,097780943	0	27,76543045	1,362722039
2435	16,51151276	50,76309967	2,080327034	0	27,83891487	1,362479329
2440	16,46046448	50,74777603	2,069230795	0	27,91212654	1,362236738
2445	16,51407623	50,69242477	2,047313929	0	27,98507881	1,361994147
2450	16,46299744	50,63628387	2,035136938	0	28,05775642	1,361751437
2455	16,51602173	50,55547714	2,014073372	0	28,13017273	1,361508846
2460	16,46388245	50,48323822	2,003522635	0	28,20233154	1,361266017
2465	16,51613998	50,39281464	1,984546781	0	28,27422905	1,361023426
2470	16,46282005	50,31520081	1,976288915	0	28,34586716	1,360780716
2475	16,51428413	50,22127914	1,959278226	0	28,41725922	1,360538244
2480	16,45972824	50,14185333	1,952965498	0	28,48839188	1,360295415
2485	16,51101303	50,0476532	1,937685847	0	28,55927658	1,360052943
2490	16,4546032	49,96826553	1,931515813	0	28,6299305	1,359810233
2495	16,50544548	49,87546921	1,914149165	0	28,70037842	1,359567404
2500	16,44744492	49,79764557	1,904873133	0	28,77059364	1,359324813
2505	16,49761009	49,70692825	1,885093808	0	28,84060478	1,359082222
2510	16,52518272	49,63048935	1,873732209	0	28,91039467	1,358839512
2515	16,48765373	49,54150391	1,852221131	0	28,97994041	1,358596921
2520	16,52500534	49,45426178	1,831525564	0	29,04929352	1,35835433
2525	16,4755764	49,37935257	1,817333341	0	29,11840248	1,358111382
2530	16,51973343	49,29245758	1,794913888	0	29,18729019	1,35786891
2535	16,4613781	49,21995163	1,780995727	0	29,25596046	1,3576262
2540	16,50794983	49,13425446	1,75786078	0	29,32439613	1,357383728
2545	16,44432259	49,06345749	1,744216442	0	29,39261436	1,357140899
2550	16,48974419	48,97929764	1,721034646	0	29,46061516	1,356898427
2555	16,52288437	48,89719772	1,699221373	0	29,52838135	1,356655717
2560	16,46697426	48,82705688	1,684545279	0	29,5959301	1,356412888
2565	16,50865555	48,7449379	1,661795974	0	29,66324425	1,356170297
2570	16,52821732	48,67751312	1,648502111	0	29,73034096	1,355927706
2575	16,48114395	48,59690857	1,625926018	0	29,79721832	1,355684996
2580	16,51761246	48,51700592	1,60404861	0	29,8638649	1,355418086
2585	16,4487114	48,44987106	1,590498805	0	29,93029022	1,355151296
2590	16,48788834	48,36446381	1,564924717	0	29,99649811	1,354835749

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
2595	16,52023315	48,27515793	1,536628723	0	30,06244659	1,354447484
2600	16,45298386	48,1961441	1,513893366	0	30,12816048	1,354132056
2605	16,49124718	48,10256195	1,480496168	0	30,19363022	1,353719592
2610	16,52306175	48,00965881	1,44626689	0	30,25886536	1,353234291
2615	16,45445633	47,92918396	1,418475628	0	30,32384109	1,352845788
2620	16,49186707	47,83498764	1,380712509	0	30,38855743	1,352457643
2625	16,52276611	47,74171829	1,371923685	0	30,45304298	1,352069378
2630	16,45315933	47,65667343	1,464894772	0	30,5173893	1,351681232
2635	16,49060059	47,55157471	1,527647972	0	30,58165359	1,351268768
2640	16,52205849	47,44449615	1,574072838	0	30,64580917	1,350807905
2645	16,4528656	47,3494873	1,614511251	0	30,70982933	1,350371122
2650	16,49074745	47,24004364	1,633965731	0	30,77368355	1,349958777
2655	16,52244186	47,13198471	1,644415855	0	30,83737373	1,349497676
2660	16,45301247	47,03819275	1,655289531	0	30,90087318	1,349061012
2665	16,49080467	46,93103027	1,649858594	0	30,96417999	1,34860003
2670	16,522295	46,82561111	1,639520288	0	31,02728271	1,348163366
2675	16,45224762	46,7350769	1,633237958	0	31,09016609	1,347823381
2680	16,48968697	46,63010788	1,613000512	0	31,15283012	1,347483397
2685	16,5207634	46,52762222	1,590830684	0	31,21529007	1,347095251
2690	16,44935989	46,44574356	1,578499794	0	31,27753067	1,34663403
2695	16,48535538	46,35613632	1,559110641	0	31,33953857	1,346197367
2700	16,51702309	46,27124405	1,541926265	0	31,40132713	1,345712066
2705	16,53077888	46,20492172	1,535748601	0	31,46291161	1,345226645
2710	16,47380829	46,12515259	1,520672083	0	31,52426147	1,344765663
2715	16,50600624	46,0472374	1,506486297	0	31,58542252	1,344280362
2720	16,52848244	45,97216415	1,494166255	0	31,64637566	1,343794942
2725	16,45560455	45,91073608	1,490322232	0	31,70709801	1,34333396
2730	16,48685837	45,83556366	1,477708459	0	31,76762962	1,342897177
2735	16,51419449	45,76251984	1,465871572	0	31,8279686	1,342484713
2740	16,52977753	45,69077301	1,454268456	0	31,88808823	1,342072248
2745	16,46120071	45,63586044	1,452414632	0	31,94800377	1,341708183
2750	16,48980331	45,56604767	1,440839767	0	32,00772858	1,3412714
2755	16,51525497	45,49753571	1,42982173	0	32,06723022	1,340859056
2760	16,52868652	45,42913818	1,41849649	0	32,1265564	1,340446591
2765	16,45772552	45,37687683	1,41689384	0	32,18566513	1,340058446
2770	16,48506165	45,29790497	1,406026721	0,058136135	32,24456787	1,339694381
2775	16,51045227	45,2096405	1,395929217	0,142111927	32,30329514	1,339257836

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
2780	16,5281868	45,12224579	1,387461424	0,226038381	32,36181259	1,338869452
2785	16,44779968	45,04783249	1,388148069	0,30988887	32,42014313	1,338456869
2790	16,47377968	44,95898438	1,380344391	0,393676519	32,47827911	1,338019848
2795	16,49840736	44,87051773	1,373411655	0,477395684	32,53620911	1,337583184
2800	16,51826096	44,78271484	1,36756289	0,561041474	32,59396362	1,337243557
2805	16,53119087	44,69374466	1,361186981	0,6446082	32,6515274	1,336855292
2810	16,45560455	44,62103653	1,365325928	0,728102148	32,70889664	1,336467147
2815	16,47949409	44,53361511	1,36024785	0,811513186	32,76607513	1,336102962
2820	16,50146866	44,44600677	1,355499029	0,894857228	32,8230896	1,335739017
2825	16,52049828	44,35979843	1,351827621	0,978120208	32,87991333	1,335350752
2830	16,52406311	44,28760147	1,357357025	1,061293721	32,93653107	1,334986925
2835	16,45339394	44,20133591	1,35401237	1,144384861	32,99297333	1,334671497
2840	16,47548866	44,11510849	1,350993872	1,227386236	33,0492363	1,334379911
2845	16,49658012	44,02937317	1,348514199	1,310307264	33,10530472	1,334040165
2850	16,51557922	43,94453049	1,346572161	1,393146992	33,16120148	1,33365202
2855	16,52191353	43,85932922	1,344634056	1,475890279	33,21691513	1,333288193
2860	16,44140625	43,78978348	1,352284551	1,558542013	33,27245331	1,332972646
2865	16,46187973	43,70552444	1,350773335	1,641100407	33,32780075	1,332729936
2870	16,47914124	43,62176895	1,349372029	1,723565817	33,3829689	1,332487106
2875	16,49599075	43,53852844	1,348292708	1,805945992	33,43795776	1,332171798
2880	16,51033592	43,45533752	1,347747087	1,888230085	33,49277115	1,33185637
2885	16,51955605	43,37154388	1,347628236	1,970433831	33,5474205	1,331516743
2890	16,5310154	43,28538895	1,346237779	2,052539587	33,60187531	1,331152797
2895	16,44461823	43,21534348	1,355452299	2,134557247	33,65616989	1,33086133
2900	16,46011162	43,13052368	1,355332255	2,216469765	33,71028519	1,33059454
2905	16,47525215	43,04588699	1,355426073	2,298283815	33,76422119	1,330254793
2910	16,48933411	42,96147537	1,355626464	2,380009413	33,81798172	1,329939008
2915	16,50297165	42,87750626	1,356039524	2,461621761	33,87158966	1,329648137
2920	16,51272202	42,79437256	1,356981635	2,543127298	33,92500687	1,329405427
2925	16,52203178	42,71158981	1,357923746	2,62453413	33,97826004	1,329065919
2930	16,53063202	42,62797546	1,358127356	2,705832243	34,03136063	1,328798771
2935	16,44034576	42,56031418	1,368247628	2,787022591	34,08425903	1,328483462
2940	16,45304108	42,47848511	1,36897397	2,868110895	34,13702011	1,328240752
2945	16,46541405	42,39698029	1,36991179	2,949090004	34,1896019	1,327997923
2950	16,47728539	42,31611252	1,370849371	3,029961109	34,24202347	1,327755213
2955	16,48853874	42,23590851	1,371892333	3,110717297	34,29426193	1,327512383
2960	16,4991436	42,15620422	1,373040438	3,191373587	34,34635544	1,327245593

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
2965	16,50871468	42,07696533	1,374188662	3,271906614	34,39826584	1,327002883
2970	16,51678658	41,99888611	1,375861645	3,352326155	34,45002747	1,326735854
2975	16,52267838	41,92094803	1,377323985	3,432635546	34,50161362	1,326468945
2980	16,52800941	41,84202194	1,377946496	3,512830734	34,55304718	1,326226473
2985	16,52954292	41,77944946	1,388738513	3,592912436	34,60430145	1,325935125
2990	16,44273186	41,70261383	1,390509009	3,672868967	34,65540695	1,325692415
2995	16,45189285	41,62625122	1,392278314	3,752710104	34,70633698	1,325449705
3000	16,4607296	41,57009888	1,394465327	3,832435846	34,75709915	1,325207114
3005	16,46968651	41,60973358	1,393931866	3,912139893	34,80771255	1,324964523
3010	16,47855186	41,61536407	1,389533639	3,991862059	34,85813522	1,324721932
3015	16,48736	41,59849548	1,383053422	4,071549416	34,90839386	1,324479222
3020	16,4956665	41,56576157	1,375538349	4,151172638	34,95847321	1,324236631
3025	16,50326538	41,52283859	1,367929816	4,230705261	35,00838852	1,32399404
3030	16,50957108	41,47327423	1,360957384	4,310109138	35,05812454	1,323751092
3035	16,51846504	41,4188385	1,354203224	4,389408588	35,10768509	1,32350862
3040	16,52244186	41,36146545	1,348395944	4,468574524	35,1570816	1,32326591
3045	16,52589035	41,30035782	1,342284799	4,547592163	35,20629883	1,323023438
3050	16,5253582	41,25332642	1,346480012	4,626467228	35,25535202	1,322780609
3055	16,53328323	41,19086838	1,34214735	4,70521307	35,30424118	1,322538137
3060	16,44305611	41,12821579	1,338340878	4,783801079	35,35296631	1,322295427
3065	16,450243	41,06488037	1,334851623	4,862238407	35,4015274	1,322052598
3070	16,45710754	41,00167465	1,332094431	4,940531731	35,44991302	1,321809769
3075	16,46388245	40,93875885	1,329756618	5,018672943	35,4981575	1,321567059
3080	16,47006798	40,87628555	1,327837586	5,096655369	35,5462265	1,321324229
3085	16,47628212	40,81424332	1,32623291	5,174485683	35,59414673	1,321081638
3090	16,48161507	40,75233078	1,324838638	5,252164364	35,64189911	1,32083869
3095	16,48732948	40,69052887	1,323550701	5,329683304	35,68948746	1,320596099
3100	16,49180794	40,62949753	1,322679281	5,407057285	35,73692703	1,320353389
3105	16,49699211	40,56808853	1,321706533	5,484272003	35,78421783	1,320110798
3110	16,50032043	40,50760651	1,321149707	5,561327934	35,83135605	1,319868207
3115	16,50515175	40,44707108	1,320491672	5,638231277	35,87833023	1,319625616
3120	16,5096302	40,3868103	1,319938779	5,714982033	35,92515564	1,319382906
3125	16,51107216	40,32763672	1,319903374	5,791574001	35,97182846	1,319140434
3130	16,51510811	40,26792526	1,319560051	5,868006229	36,01835251	1,318897843
3135	16,51876068	40,20912552	1,31942451	5,944279194	36,06470871	1,318655133
3140	16,51737595	40,15059662	1,319599152	6,020406246	36,1109314	1,318412542
3145	16,52035141	40,09170151	1,319363713	6,096374035	36,15700531	1,318169951

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
3150	16,5229435	40,03371811	1,319437981	6,172175407	36,20291138	1,317927361
3155	16,52515221	39,97583771	1,319513559	6,247824192	36,24868393	1,31768465
3160	16,522089	39,91711807	1,318974257	6,323327541	36,29430389	1,317441821
3165	16,52362061	39,85945892	1,318847299	6,39867115	36,33977127	1,317199111
3170	16,52485847	39,80238724	1,318927169	6,47384119	36,38508987	1,316956282
3175	16,52574158	39,74574661	1,319007874	6,548865318	36,4302597	1,316713691
3180	16,52621269	39,68904877	1,318577886	6,623730183	36,47529221	1,316470742
3185	16,5264492	39,63293457	1,318046927	6,69843483	36,52018738	1,316228151
3190	16,52624321	39,57707977	1,317312837	6,772993088	36,56494522	1,315985322
3195	16,52574158	39,52149582	1,316376209	6,847378254	36,60953903	1,31574285
3200	16,5249176	39,4666481	1,315442443	6,92160368	36,65401077	1,31550014
3205	16,52376938	39,41222382	1,314510226	6,995682716	36,69832993	1,315257668
3210	16,52232552	39,35774612	1,313274622	7,069588661	36,74251556	1,315014839
3215	16,52538872	39,30479813	1,312551379	7,143348217	36,78656387	1,314772367
3220	16,52326775	39,25131226	1,311218739	7,216947556	36,83045959	1,314529657
3225	16,52070427	39,19776917	1,309786201	7,29038763	36,87421799	1,314286947
3230	16,51793671	39,14464951	1,308152914	7,363667488	36,91784286	1,314044356
3235	16,51481247	39,09147263	1,306421041	7,436787128	36,96131516	1,313801765
3240	16,51605034	39,03871536	1,304590344	7,509760857	37,00466537	1,313559055
3245	16,51227951	38,98667908	1,302966595	7,582560539	37,04786301	1,313316464
3250	16,50821495	38,9347496	1,301345348	7,65521431	37,09092712	1,313073874
3255	16,50665474	38,88275528	1,29952395	7,727707386	37,1338501	1,312831402
3260	16,50202942	38,83102036	1,297502756	7,80002737	37,17663956	1,312588573
3265	16,49725723	38,77796555	1,294469714	7,872200489	37,21930313	1,312345862
3270	16,49398804	38,72404861	1,290325165	7,944198608	37,26180649	1,312103033
3275	16,48886108	38,66990662	1,285882354	8,016049385	37,30417252	1,311860323
3280	16,4836483	38,61554718	1,28073585	8,087725639	37,34641266	1,311617613
3285	16,47919846	38,56079483	1,274887204	8,159239769	37,38848877	1,311374784
3290	16,47357368	38,50598145	1,268640995	8,230592728	37,43043137	1,311132193
3295	16,46833038	38,45171738	1,262200594	8,30177021	37,47223282	1,310889602
3300	16,46232033	38,39770126	1,255566001	8,37279892	37,5138855	1,310646892
3305	16,45642853	38,34392166	1,248736978	8,443653107	37,55540466	1,310404301
3310	16,450037	38,2902298	1,241714954	8,514345169	37,59679794	1,31016171
3315	16,44346809	38,23678207	1,234499812	8,584875107	37,63802719	1,309919
3320	16,43689919	38,18357849	1,227192402	8,655243874	37,67913055	1,309676528
3325	16,53310585	38,13061523	1,219893694	8,725450516	37,72008896	1,309433818
3330	16,52615356	38,07804871	1,212604284	8,795482635	37,76087952	1,309191346

TIME	WHPI	QMGA	QMGB	NSGA	NSGB	PRB
3335	16,52904129	38,01084518	1,195649505	8,865365982	37,80155945	1,308948517
3340	16,52659607	37,96002197	1,188986897	8,935087204	37,84210587	1,308706045
3345	16,5190258	37,90849686	1,197633862	9,004633904	37,88249969	1,308463335
3350	16,51602173	37,85408401	1,246921182	9,07403183	37,92281342	1,308220744
3355	16,50848007	37,79771423	1,288212776	9,143253326	37,96306992	1,307978034
3360	16,50385666	37,73954391	1,322225332	9,212311745	38,00324631	1,307735324
3365	16,49646187	37,68128967	1,350577831	9,281191826	38,04334259	1,307492495
3370	16,49068832	37,62279129	1,373680592	9,349908829	38,08333969	1,307249784
3375	16,4832058	37,56483078	1,392545223	9,418460846	38,12325668	1,307006955
3380	16,47669601	37,50786972	1,40808177	9,48683548	38,16306305	1,306764245
3385	16,46965599	37,45129013	1,420294642	9,555059433	38,20275879	1,306521773
3390	16,46190834	37,39585876	1,429991007	9,623106003	38,24233246	1,306279063
3395	16,4543972	37,34097672	1,437274933	9,690975189	38,28181076	1,306036472
3400	16,44650269	37,2863121	1,442450762	9,758695602	38,32115173	1,305793881
3405	16,43860817	37,23265457	1,446021557	9,826238632	38,36038589	1,305551291
3410	16,53513908	37,17969513	1,448090196	9,893631935	38,39950562	1,30530858
3415	16,53720093	37,11174774	1,438963652	9,96086216	38,43849182	1,305065989
3420	16,5288353	37,06034088	1,439038277	10,02792931	38,47735596	1,304823518
3425	16,52524185	37,01039505	1,438614964	10,09483528	38,51609421	1,304580688
3430	16,51658249	36,95943832	1,43659699	10,16160488	38,55472565	1,304338217
3435	16,51242828	36,90886688	1,433684587	10,22822666	38,5932045	1,304095507
3440	16,50624084	36,85851669	1,430277467	10,29467106	38,63157654	1,303853035
3445	16,49711037	36,80918121	1,426975369	10,36098099	38,66980743	1,303610325
3450	16,48948097	36,75991058	1,422980905	10,42711544	38,70792007	1,303367734
3455	16,48099518	36,71102905	1,418792605	10,49310112	38,74588013	1,303124785
3460	16,47130585	36,66238022	1,414410591	10,55893803	38,78372955	1,302882195
3465	16,46205711	36,61441422	1,409835815	10,62462711	38,82145691	1,302639365
3470	16,45233345	36,56652832	1,40506804	10,69016743	38,85904694	1,302396655
3475	16,44223022	36,51886749	1,400207043	10,75554562	38,89649963	1,302153826
3480	16,5382328	36,47190475	1,395352125	10,82077599	38,93384552	1,301911354
3485	16,52777481	36,42639923	1,391396999	10,88585758	38,97103882	1,301668525
3490	16,52756882	36,36573792	1,377526164	10,95080566	39,00812149	1,301426053
3495	16,52153015	36,32362366	1,375569582	11,01557827	39,04508591	1,301183343
3500	16,5148716	36,28098297	1,373021245	11,08023167	39,08192062	1,300940752

Table A.4 shows selected parameter values (set 3): PSGA/B, WBK.

Table A.4 – Selected parameter values for small main steam line break (set 3).

TIME	PSGA	PSGB	WBK
0	55,00490952	55,00490952	0
5	55,03376007	55,03376007	0
10	55,04692841	55,04692841	0
15	55,06156158	55,06156158	0
20	55,07236862	55,07236862	0
25	55,07818604	55,07818604	0
30	55,08256149	55,08256149	0
35	55,08662796	55,08662796	0
40	55,08939362	55,08939362	0
45	55,09095383	55,09095383	0
50	55,09218597	55,09218597	0
55	55,09327316	55,09327316	0
60	55,09397888	55,09397888	0
65	55,09440613	55,09440613	0
70	55,09476852	55,09476852	0
75	55,09506989	55,09506989	0
80	55,09527206	55,09527206	0
85	55,09540176	55,09540176	0
90	55,09548569	55,09548569	0
95	55,09553528	55,09553528	0
100	55,09559631	55,09559631	0
105	54,05049515	55,038311	280,1255188
110	53,25234222	54,9303627	275,7721252
115	52,67617416	54,84188461	272,6187439
120	52,26631546	54,78482056	270,3753357
125	51,96622086	54,74384308	268,7352905
130	51,74391937	54,71373367	267,5177612
135	51,57968521	54,69323349	266,6162415
140	51,45674133	54,67906952	265,9403687
145	51,36309052	54,66891861	265,4239502
150	51,29065704	54,66159058	265,0229492
155	51,2334137	54,65607452	264,704895
160	51,1871376	54,65174484	264,4464722

TIME	PSGA	PSGB	WBK
165	51,1488533	54,64823532	264,2316284
170	51,11631012	54,64517593	264,0480652
175	51,08785248	54,64229584	263,8868408
180	51,06239319	54,63947678	263,7415771
185	51,03915405	54,63661575	263,6083069
190	51,01755524	54,63365173	263,4839478
195	50,99720001	54,63055038	263,366333
200	50,97780991	54,62727737	263,2539368
205	50,95918655	54,62382889	263,1457214
210	50,94118118	54,62017822	263,040802
215	50,92372131	54,61634827	262,9388123
220	50,90668869	54,61229706	262,8391418
225	50,89004517	54,6080246	262,7415161
230	50,873806	54,60356903	262,6460876
235	50,85790634	54,59889984	262,5524597
240	50,84230423	54,59400177	262,4604187
245	50,82701111	54,58888626	262,3699646
250	50,81206131	54,58359146	262,2814026
255	50,79737854	54,57806015	262,1942444
260	50,78297043	54,57231522	262,1086731
265	50,76882935	54,56634521	262,0240173
270	50,75496674	54,56016159	261,9408264
275	50,74139023	54,5537796	261,8592224
280	50,72807693	54,54718018	261,7789001
285	50,71504593	54,54039383	261,7001343
290	50,70222473	54,53336334	261,6225281
295	50,6896553	54,52613831	261,5462341
300	50,67731476	54,51869965	261,4707031
305	50,66519547	54,51104355	261,3962708
310	50,65332031	54,50320435	261,3231201
315	50,64165497	54,49517059	261,2511292
320	50,63021088	54,48695755	261,1802979
325	50,61896896	54,47854614	261,1105042
330	50,60793686	54,46995926	261,0418701
335	50,59708405	54,46118164	260,9741516
340	50,58642578	54,4522438	260,9075317
345	50,57590866	54,44310379	260,8416443

TIME	PSGA	PSGB	WBK
350	50,56559372	54,43381882	260,776825
355	50,55539322	54,42433929	260,7126465
360	50,54537964	54,41472244	260,6493835
365	50,53549957	54,40494919	260,5866089
370	50,52574921	54,39501572	260,5242615
375	50,51615906	54,38496017	260,4628296
380	50,50664902	54,37473679	260,4017944
385	50,49728394	54,36441803	260,3415527
390	50,48799133	54,3539505	260,2817383
395	50,47882843	54,34336472	260,2221069
400	50,46977234	54,33267212	260,1630554
405	50,46077347	54,32186127	260,104248
410	50,45187759	54,31095886	260,046051
415	50,44304657	54,29995346	259,9881287
420	50,43428802	54,28885269	259,9306946
425	50,42559052	54,27767563	259,8735352
430	50,41691971	54,2664032	259,8165894
435	50,40832901	54,25506973	259,7599792
440	50,39978409	54,2436676	259,7036743
445	50,39125824	54,23218155	259,6474915
450	50,38280106	54,22065735	259,5916443
455	50,37434387	54,20904922	259,5358582
460	50,36593628	54,19742584	259,4803162
465	50,35752106	54,18574524	259,4247742
470	50,34913254	54,17400742	259,3693542
475	50,34085083	54,16231155	259,3143311
480	50,3333168	54,15118408	259,2626343
485	50,32717133	54,14120483	259,2176514
490	50,32220459	54,13229752	259,1792908
495	50,31768417	54,12390137	259,1435547
500	50,31343079	54,11587143	259,1092224
505	50,30952072	54,10826492	259,0766907
510	50,30581284	54,10094833	259,045166
515	50,30234909	54,09394455	259,0143738
520	50,29935455	54,08744431	258,9859314
525	50,29692078	54,08153915	258,9605103
530	50,29521179	54,07637787	258,9388123

TIME	PSGA	PSGB	WBK
535	50,29404831	54,07182693	258,9200745
540	50,29348755	54,0679245	258,9043884
545	50,29333878	54,06458282	258,8912659
550	50,2935791	54,06174469	258,8800354
555	50,29421234	54,05940628	258,8709412
560	50,29507828	54,05744934	258,8631592
565	50,29606247	54,05575562	258,8560486
570	50,2971077	54,05425644	258,8493042
575	50,29815674	54,05290985	258,8426208
580	50,29923248	54,05170822	258,8360291
585	50,30028915	54,05060577	258,8293762
590	50,3013382	54,04959106	258,8227539
595	50,30236053	54,04865646	258,8159485
600	50,30335999	54,04778671	258,8090515
605	50,30432892	54,04697418	258,8017273
610	50,30525589	54,04620743	258,7938538
615	50,3061676	54,04548264	258,7858887
620	50,30703735	54,04481125	258,77771
625	50,3078804	54,04416656	258,7691345
630	50,30868149	54,04354858	258,7600403
635	50,30947113	54,04299164	258,7508545
640	50,31021881	54,04245377	258,7414551
645	50,3109436	54,04194641	258,7319946
650	50,31162643	54,04145432	258,722229
655	50,31229401	54,04099274	258,7125244
660	50,31291962	54,04056549	258,7025757
665	50,31352615	54,04016876	258,6925354
670	50,31409836	54,03981018	258,682251
675	50,31466293	54,03950882	258,6719971
680	50,31517792	54,0391922	258,6614685
685	50,31568146	54,03893661	258,6508789
690	50,31616211	54,03863907	258,6401978
695	50,31660461	54,03834534	258,6293335
700	50,31702423	54,03808594	258,6183167
705	50,31744003	54,03785706	258,6065674
710	50,31782913	54,03765106	258,5946655
715	50,31820679	54,03747559	258,5827332

TIME	PSGA	PSGB	WBK
720	50,31856918	54,03730774	258,5707397
725	50,31891251	54,03715897	258,5583801
730	50,12443161	53,96111298	257,9779053
735	49,63907242	53,64019775	255,1105804
740	49,34158707	53,44234848	253,5453339
745	49,00601578	53,19534302	251,7635651
750	48,74897003	52,98788452	250,3388977
755	48,58026123	52,83265305	249,4113464
760	48,42021561	52,67567062	248,5711517
765	48,2339859	52,47758484	247,5874176
770	48,04462051	52,24615097	246,5798798
775	53,27777481	56,01237488	271,3517761
780	57,94649506	59,77211761	296,488739
785	61,12689209	62,31881332	314,1607361
790	62,97932816	64,17546082	324,4327087
795	64,07285309	65,35040283	330,566864
800	64,49443054	65,89356995	333,0952454
805	64,45800781	65,96870422	333,0643616
810	64,20283508	65,77162933	331,7820129
815	63,12872314	65,43291473	326,8405762
820	61,69379044	65,02497101	319,039978
825	60,48887253	64,6234436	312,5956726
830	59,41940308	64,24303436	306,8765259
835	58,46572113	63,89141846	301,7784119
840	57,61227036	63,57266998	297,2168274
845	56,84575272	63,2348938	293,1216431
850	56,14947891	62,85673141	289,405365
855	55,51926422	62,45467758	286,0275269
860	54,98116302	62,03924561	283,1360779
865	54,50675201	61,61101532	280,5961609
870	54,06521225	61,16839981	278,2489624
875	53,63338089	60,7162056	275,9578857
880	53,20926285	60,25995636	273,7084045
885	52,79152298	59,8000412	271,4931641
890	52,37888718	59,33651733	269,3055725
895	51,97039795	58,86994934	267,1401672
900	51,56555557	58,40150452	264,9942017

TIME	PSGA	PSGB	WBK
905	51,16403198	57,93214417	262,8659363
910	50,76574326	57,46257401	260,7547302
915	50,37029648	56,99334717	258,6587219
920	49,97756958	56,52490997	256,5770874
925	49,58746719	56,05761337	254,509491
930	49,20004272	55,59938812	252,457016
935	48,81760025	55,17164612	250,4266663
940	48,45716858	54,76434708	248,5050507
945	48,11765289	54,36943436	246,6976013
950	47,7925415	53,97248459	244,9690857
955	47,47716522	53,57054138	243,295166
960	47,15989685	53,16613388	241,6174469
965	46,83773804	52,76050949	239,9126282
970	46,51576614	52,35453415	238,2060852
975	46,1955986	51,94878769	236,50914
980	45,87703323	51,54343033	234,8208008
985	45,55964279	51,13754654	233,138916
990	45,24274063	50,73012924	231,4600067
995	44,92568588	50,32040787	229,7815704
1000	44,60797119	49,90799713	228,1003265
1005	44,28962326	49,49389648	226,4156189
1010	43,97093201	49,07939148	224,7284241
1015	43,65228271	48,67073822	223,0409698
1020	43,3352356	48,28243637	221,3611603
1025	43,02127838	47,90801239	219,6977539
1030	42,7111702	47,5426178	218,0543518
1035	42,40507889	47,17568207	216,4322968
1040	42,10217667	46,80289841	214,8275757
1045	41,80760193	46,44032669	213,2602386
1050	41,5293541	46,08964157	211,77948
1055	41,26311493	45,74837875	210,3642426
1060	41,00517273	45,41475677	208,9943848
1065	40,75349045	45,08746338	207,6582947
1070	40,50489044	44,76554871	206,3419647
1075	40,25263596	44,44796371	205,0078125
1080	39,99728775	44,13380051	203,6567688
1085	39,7398262	43,82246017	202,2940826

TIME	PSGA	PSGB	WBK
1090	39,48078918	43,51283646	200,9230499
1095	39,21976852	43,20205307	199,5419159
1100	38,95600128	42,88740158	198,1467133
1105	38,68859482	42,56682968	196,7331848
1110	38,41675949	42,23923492	195,2970581
1115	38,14093018	41,90858078	193,839386
1120	37,62142944	41,80544662	191,4868317
1125	36,64337158	42,04740524	186,283905
1130	35,74080276	42,18861389	181,4805603
1135	34,91476822	42,24668503	177,0670013
1140	34,23361206	42,24002457	173,3932495
1145	33,66028595	42,18322372	170,3233643
1150	33,12921524	42,08748245	167,5070648
1155	32,61972427	41,96223831	164,8049774
1160	32,13142776	41,81657791	162,2156219
1165	31,66406441	41,65619659	159,7355804
1170	31,22005653	41,48513794	157,3816071
1175	30,79492188	41,30633163	155,1275787
1180	30,38766479	41,1216011	152,9684906
1185	29,99438095	40,93247986	150,8854523
1190	29,61625862	40,74020767	148,8810272
1195	29,25304794	40,54467773	146,9557495
1200	28,90585518	40,34315491	145,1122742
1205	28,58082581	40,13628769	143,384613
1210	28,27593231	39,92477036	141,7645721
1215	27,99785805	39,70924377	140,2779999
1220	27,75049782	39,49040604	138,9587555
1225	27,52517319	39,26896286	137,7602539
1230	27,31549072	39,04559326	136,6472168
1235	27,11761665	38,82092285	135,5979156
1240	26,92921638	38,59550858	134,5996704
1245	26,74686813	38,3698349	133,6363373
1250	26,56553459	38,14428711	132,6794586
1255	26,38517952	37,9192009	131,7276001
1260	26,20596886	37,69482803	130,781723
1265	26,02805901	37,47177505	129,8426208
1270	25,85157967	37,25072479	128,9109955

TIME	PSGA	PSGB	WBK
1275	25,67663956	37,03164291	127,9874344
1280	25,5033474	36,81449127	127,0725174
1285	25,33179092	36,59924698	126,166687
1290	25,16204453	36,38587189	125,2703934
1295	24,99417686	36,17435074	124,3839645
1300	24,82824707	35,96466827	123,5077362
1305	24,66429901	35,75679398	122,6419449
1310	24,50237465	35,5507164	121,7867966
1315	24,34250069	35,34641266	120,9424515
1320	24,18470764	35,14387894	120,1090775
1325	24,02900505	34,94688797	119,286705
1330	23,87542915	34,75722122	118,4755402
1335	23,72400856	34,57336807	117,6757278
1340	23,57479095	34,39421844	116,8875046
1345	23,4278183	34,2186203	116,1110992
1350	23,28313065	34,04602051	115,3467255
1355	23,14075851	33,87608719	114,5945587
1360	23,00071144	33,70825195	113,8546677
1365	22,86301804	33,53969574	113,1271515
1370	22,72766304	33,37018204	112,4119949
1375	22,59561729	33,20012283	111,7131195
1380	22,46852875	33,02978134	111,0402756
1385	22,3459301	32,85935974	110,3913727
1390	22,22737312	32,68903351	109,7641678
1395	22,11245728	32,51896667	109,1576843
1400	22,00084114	32,34929657	108,5689087
1405	21,89222336	32,18014908	107,9961243
1410	21,78635025	32,01163483	107,4379196
1415	21,68300056	31,84384537	106,8931503
1420	21,58197594	31,67716217	106,360733
1425	21,48311424	31,51247215	105,8398056
1430	21,38626671	31,34863853	105,3295593
1435	21,29241943	31,18572807	104,833931
1440	21,20304871	31,02372742	104,3620834
1445	21,11702919	30,86254692	103,9084091
1450	21,03374672	30,70179367	103,4694214
1455	20,95280647	30,54169846	103,0429764

TIME	PSGA	PSGB	WBK
1460	20,87389946	30,38244247	102,6273956
1465	20,79678154	30,22323608	102,2213669
1470	20,72126198	30,06482697	101,8238525
1475	20,64714813	29,90771866	101,4339066
1480	20,57411003	29,7519722	101,0497665
1485	20,50203133	29,59758186	100,6707153
1490	20,4308567	29,44458389	100,2964706
1495	20,36055946	29,2930088	99,92685699
1500	20,29107094	29,14279556	99,56156921
1505	20,22220993	28,9961853	99,19971466
1510	20,15370178	28,85582542	98,83987427
1515	20,08530235	28,72011757	98,48071289
1520	20,01677704	28,58777046	98,1210556
1525	19,94771957	28,45774078	97,75892639
1530	19,87731934	28,32920456	97,38996887
1535	19,80548477	28,20181465	97,01347351
1540	19,73221779	28,07704544	96,62939453
1545	19,65759277	27,95445442	96,23806763
1550	19,58187485	27,83377647	95,84082794
1555	19,50534439	27,71488571	95,43916321
1560	19,42819023	27,59768295	95,03414917
1565	19,35064697	27,48199081	94,62689209
1570	19,27297211	27,36753464	94,21884918
1575	19,19532967	27,25429153	93,8108902
1580	19,11787415	27,14223671	93,40385437
1585	19,04072762	27,03134727	92,99836731
1590	18,96400261	26,92159843	92,59505463
1595	18,8907032	26,81262016	92,20819092
1600	18,81791878	26,7033577	91,82574463
1605	18,74548149	26,5939064	91,44511414
1610	18,67344284	26,4843998	91,06652832
1615	18,60186958	26,37499428	90,69039917
1620	18,53082275	26,26582336	90,31700134
1625	18,46035194	26,15698242	89,94660187
1630	18,39048576	26,04855156	89,57939148
1635	18,32126045	25,94059753	89,21554565
1640	18,2526741	25,83317184	88,85505676

TIME	PSGA	PSGB	WBK
1645	18,18479347	25,72631645	88,49826813
1650	18,11760902	25,62005997	88,14517212
1655	18,05113792	25,51442528	87,79581451
1660	17,98538017	25,40944099	87,45023346
1665	17,92034721	25,30511093	87,10845184
1670	17,85603714	25,20145226	86,77048492
1675	17,79247475	25,09850883	86,43645477
1680	17,7296772	24,99633217	86,10644531
1685	17,66757011	24,89491463	85,78015137
1690	17,60618591	24,79425621	85,45759583
1695	17,54403877	24,69434929	85,13259125
1700	17,48141479	24,59518433	84,80331421
1705	17,41988754	24,49674416	84,47985077
1710	17,35939217	24,39902115	84,16184998
1715	17,29987907	24,30200195	83,84907532
1720	17,24129105	24,20567703	83,54125977
1725	17,18349266	24,11004448	83,23754883
1730	17,12656593	24,01509857	82,93846893
1735	17,07047653	23,92083168	82,64381409
1740	17,01537704	23,82723808	82,35407257
1745	16,96209717	23,73428917	82,07370758
1750	16,91051102	23,64189529	81,80242157
1755	16,86030197	23,54983139	81,5385437
1760	16,81131172	23,45808983	81,28115845
1765	16,76341629	23,36669159	81,02960205
1770	16,71650696	23,27564812	80,78330994
1775	16,67048645	23,18497849	80,54175568
1780	16,62527657	23,09469986	80,30450439
1785	16,58081055	23,00481415	80,0712204
1790	16,53702354	22,91533089	79,8415451
1795	16,49385262	22,82624245	79,61515045
1800	16,4511776	22,73744011	79,39146423
1805	16,40882683	22,64932632	79,16960144
1810	16,36664581	22,56353378	78,94864655
1815	16,32456207	22,47966194	78,72828674
1820	16,28246307	22,3972435	78,50788879
1825	16,24025154	22,31589127	78,28694916

TIME	PSGA	PSGB	WBK
1830	16,19786263	22,23530197	78,06510162
1835	16,15524483	22,15522766	77,84207153
1840	16,11235428	22,07546806	77,61761475
1845	16,06916237	21,99585342	77,39159393
1850	16,02564812	21,91627693	77,16387177
1855	15,98188782	21,83675194	76,93478394
1860	15,93798447	21,75737572	76,70488739
1865	15,8940239	21,67821312	76,47465515
1870	15,85007477	21,59931564	76,24445343
1875	15,80619907	21,52072906	76,01461029
1880	15,7624464	21,44249535	75,7853775
1885	15,71885681	21,364645	75,55699158
1890	15,67546654	21,28785133	75,32965088
1895	15,63230324	21,21247292	75,10348511
1900	15,58939552	21,13832092	74,87865448
1905	15,54676819	21,06524658	74,65528107
1910	15,50444984	20,99313354	74,43353271
1915	15,4624548	20,92189407	74,21347809
1920	15,42080498	20,8514595	73,99523163
1925	15,37951279	20,78177071	73,77886963
1930	15,33859253	20,71277618	73,56446075
1935	15,29805279	20,6444149	73,35186005
1940	15,25790024	20,5765152	73,14115143
1945	15,21814156	20,50905609	72,93251038
1950	15,17877579	20,44203758	72,72594452
1955	15,13980198	20,37545395	72,52145386
1960	15,10121822	20,30930138	72,31902313
1965	15,06301975	20,24358368	72,11862183
1970	15,02520275	20,17829514	71,92023468
1975	14,98776054	20,11342621	71,72383118
1980	14,95069027	20,04896545	71,5293808
1985	14,91398239	19,98491287	71,33686066
1990	14,87763214	19,92094231	71,14622498
1995	14,84162903	19,85687828	70,95742798
2000	14,80596638	19,79278755	70,77043152
2005	14,77062988	19,7287159	70,5851593
2010	14,73560333	19,664711	70,4015274

TIME	PSGA	PSGB	WBK
2015	14,70087814	19,60080338	70,21949005
2020	14,6664362	19,53702736	70,03948212
2025	14,63226604	19,47340965	69,86128235
2030	14,59835148	19,40996552	69,68457031
2035	14,56468296	19,34671021	69,5091629
2040	14,53125	19,28366089	69,33513641
2045	14,49804306	19,22083092	69,16242981
2050	14,46506405	19,15822792	68,9908905
2055	14,43244457	19,09585953	68,82107544
2060	14,40018272	19,03372765	68,65328217
2065	14,36823177	18,97184563	68,48722076
2070	14,33648777	18,9135952	68,32218933
2075	14,30504036	18,85604095	68,15871429
2080	14,27388382	18,79836082	67,99678802
2085	14,24300861	18,7406292	67,83634949
2090	14,2124052	18,68289375	67,67735291
2095	14,18206024	18,62519836	67,51972198
2100	14,15196228	18,56758118	67,36340332
2105	14,12227631	18,51026917	67,20900726
2110	14,09351444	18,45386505	67,05938721
2115	14,06554317	18,39829636	66,91403961
2120	14,0382185	18,34345627	66,77216339
2125	14,01142502	18,28926277	66,63314056
2130	13,985075	18,23575974	66,49649811
2135	13,95909786	18,18283653	66,36186218
2140	13,93343639	18,130373	66,22891998
2145	13,90804958	18,07833672	66,097435
2150	13,8829031	18,02669334	65,96723938
2155	13,85796928	17,97542763	65,83818054
2160	13,83323193	17,92452049	65,7101593
2165	13,808671	17,87395859	65,58308411
2170	13,78427315	17,82372856	65,45687866
2175	13,76001549	17,77381897	65,33141327
2180	13,73588181	17,724226	65,20661926
2185	13,71187305	17,6749382	65,08247375
2190	13,68787003	17,6258297	64,95857239
2195	13,73303699	17,57594872	64,8321991

TIME	PSGA	PSGB	WBK
2200	14,29548359	17,51298141	67,90383148
2205	14,67570114	17,43648529	70,00139618
2210	14,90582657	17,35352707	71,28274536
2215	15,03667545	17,26817322	72,01669312
2220	15,1040163	17,18279266	72,4003067
2225	15,13080311	17,09867477	72,56020355
2230	15,13179111	17,01660919	72,57772827
2235	15,11621284	16,93830299	72,5039444
2240	15,0898447	16,86386108	72,37084198
2245	15,05630493	16,79281616	72,19835663
2250	15,01791191	16,72469711	71,99928284
2255	14,9761591	16,65906715	71,78183746
2260	14,93206787	16,59555244	71,55158234
2265	14,88645458	16,53388786	71,31292725
2270	14,83988285	16,47384644	71,0689621
2275	14,79273033	16,41523743	70,82177734
2280	14,7452507	16,35789108	70,57275391
2285	14,69762421	16,30166626	70,32286835
2290	14,64997101	16,24643707	70,07278442
2295	14,60238171	16,19210815	69,82300568
2300	14,5549202	16,13858795	69,57387543
2305	14,50762939	16,08580399	69,32562256
2310	14,4605732	16,03369522	69,07852173
2315	14,41400528	15,98221302	68,83390045
2320	14,36793041	15,93131638	68,59191895
2325	14,32228947	15,88097	68,35224915
2330	14,27705097	15,83115101	68,11470795
2335	14,23219299	15,78183746	67,87918091
2340	14,18770409	15,73301029	67,64561462
2345	14,14357662	15,68465614	67,41395569
2350	14,09980392	15,63676071	67,18417358
2355	14,05635834	15,5892992	66,95617676
2360	14,01318264	15,54223537	66,72952271
2365	13,97037983	15,4956007	66,50485229
2370	13,92785549	15,44935131	66,28170776
2375	13,88567066	15,40350342	66,06028748
2380	13,84380817	15,35804272	65,84062958

TIME	PSGA	PSGB	WBK
2385	13,80224514	15,3129549	65,62248993
2390	13,76102734	15,26826096	65,40625763
2395	13,72001266	15,22390938	65,19103241
2400	13,67932224	15,17994499	64,9775238
2405	13,63885403	15,13631058	64,7652359
2410	13,59871292	15,09304905	64,55461121
2415	13,558815	15,05011272	64,34532928
2420	13,51923943	15,00753212	64,13768768
2425	13,48000622	14,96527576	63,93164825
2430	13,44249535	14,92333984	63,7340126
2435	13,4065485	14,88165283	63,54502106
2440	13,37171841	14,84020329	63,36207199
2445	13,33765221	14,79896164	63,18334198
2450	13,30417919	14,75793171	63,00776291
2455	13,27114582	14,71710873	62,83462524
2460	13,23849773	14,67650318	62,66348648
2465	13,20615673	14,63611031	62,49406433
2470	13,17411327	14,59594536	62,32614899
2475	13,14232063	14,55600357	62,15963364
2480	13,11078548	14,51629925	61,99442673
2485	13,07946014	14,47681999	61,83039474
2490	13,04837036	14,43764973	61,66754913
2495	13,01745224	14,39881897	61,50568008
2500	12,98678017	14,36034298	61,34503174
2505	12,95627213	14,32217312	61,18532181
2510	12,92601871	14,28433704	61,0268898
2515	12,89591789	14,24677944	60,86931992
2520	12,86606121	14,20953274	60,71302795
2525	12,83637905	14,17255878	60,55761719
2530	12,80691624	14,13587093	60,40341187
2535	12,77765083	14,09945297	60,25019455
2540	12,74857235	14,06329632	60,09802246
2545	12,7197237	14,02741241	59,9469986
2550	12,69103622	13,99176979	59,79689026
2555	12,66257763	13,9563942	59,64797592
2560	12,6342907	13,92125511	59,49992752
2565	12,60619831	13,88636112	59,35295868

TIME	PSGA	PSGB	WBK
2570	12,57831955	13,851717	59,20705414
2575	12,55059433	13,81729603	59,06201935
2580	12,52307987	13,78311825	58,91822052
2585	12,49575329	13,74915123	58,77523422
2590	12,46855545	13,71535206	58,63339233
2595	12,44149208	13,68172646	58,49266052
2600	12,41450405	13,64824009	58,35190582
2605	12,38756275	13,61487675	58,2119751
2610	12,36067677	13,5816412	58,07271957
2615	12,33381939	13,54850769	57,93305588
2620	12,30697918	13,51546955	57,79354095
2625	12,28019714	13,48255634	57,65444946
2630	12,25342751	13,4502182	57,51514053
2635	12,226614	13,41853523	57,37593079
2640	12,19975758	13,38741684	57,23675537
2645	12,17282581	13,35676479	57,09701157
2650	12,14581013	13,32650566	56,95675659
2655	12,11874294	13,29659367	56,81646729
2660	12,09161091	13,26697063	56,67565536
2665	12,06441402	13,23758984	56,53468323
2670	12,03719425	13,20843315	56,39358139
2675	12,00993729	13,17945957	56,25158691
2680	11,98264503	13,1506424	56,10932541
2685	11,95535469	13,1219759	55,96745682
2690	11,92807293	13,09344006	55,82592773
2695	11,90083122	13,06503582	55,68452072
2700	11,87371349	13,03678417	55,54401016
2705	11,84673119	13,00868702	55,40413284
2710	11,81986046	12,98073101	55,26478577
2715	11,79315472	12,95293713	55,12641525
2720	11,76661777	12,92530918	54,98893738
2725	11,74023151	12,89783669	54,85206985
2730	11,71400166	12,87052155	54,71595383
2735	11,68791962	12,84337616	54,580513
2740	11,66196918	12,81639004	54,445755
2745	11,63614368	12,78955841	54,31146622
2750	11,61046696	12,76288986	54,17827988

TIME	PSGA	PSGB	WBK
2755	11,58493996	12,73637867	54,04561996
2760	11,55956173	12,71002674	53,91400909
2765	11,53431702	12,68382454	53,78277588
2770	11,50925446	12,65777397	53,65239716
2775	11,48441887	12,63188362	53,52360916
2780	11,45979881	12,60615253	53,39557266
2785	11,43537903	12,58058071	53,26879883
2790	11,41114616	12,55516529	53,14319611
2795	11,38711548	12,52991772	53,01866531
2800	11,3632803	12,50484085	52,89477921
2805	11,33962631	12,47992611	52,77184677
2810	11,3161459	12,45517445	52,65003967
2815	11,29284477	12,43058872	52,52897263
2820	11,26973248	12,40617752	52,40890121
2825	11,24679184	12,38192272	52,28986359
2830	11,22403336	12,35782528	52,17148972
2835	11,20142746	12,33387661	52,05383682
2840	11,17899036	12,3100853	51,9370842
2845	11,15672112	12,28645039	51,82133865
2850	11,13461971	12,26297283	51,7067337
2855	11,11268902	12,23965645	51,59277725
2860	11,09091091	12,21649361	51,4795723
2865	11,06928349	12,19348431	51,36670303
2870	11,04781914	12,17063236	51,25469971
2875	11,02650547	12,14793301	51,14373779
2880	11,00538158	12,12539101	51,03388977
2885	10,98445034	12,1030035	50,92531204
2890	10,9636898	12,08076859	50,81752014
2895	10,94309521	12,0586853	50,71042633
2900	10,92266273	12,03675461	50,60398865
2905	10,90238857	12,0149765	50,49876404
2910	10,88227558	11,99335289	50,39426804
2915	10,86231422	11,97188091	50,29031372
2920	10,84250736	11,95056248	50,18717575
2925	10,82284451	11,92939281	50,085186
2930	10,80332947	11,90837288	49,98358917
2935	10,78395653	11,88750267	49,88295746

TIME	PSGA	PSGB	WBK
2940	10,76472569	11,86678028	49,7827301
2945	10,74563599	11,8462038	49,68325806
2950	10,72668266	11,82577419	49,58450317
2955	10,70787048	11,80548954	49,48648071
2960	10,68919563	11,78535175	49,38932419
2965	10,67065525	11,76535797	49,2927475
2970	10,65225029	11,74550343	49,19701004
2975	10,63397884	11,72579288	49,10185242
2980	10,615839	11,70621967	49,00751877
2985	10,59782982	11,68677521	48,91395569
2990	10,57994556	11,66745567	48,82083893
2995	10,56218815	11,64826488	48,72839355
3000	10,54457664	11,62920284	48,63665771
3005	10,52760506	11,61026192	48,54798126
3010	10,51133347	11,5914259	48,46312332
3015	10,49557209	11,57268333	48,38103485
3020	10,48019505	11,5540266	48,30104065
3025	10,46511364	11,53545189	48,22263718
3030	10,45026779	11,51696205	48,14550018
3035	10,43560982	11,49855232	48,06937408
3040	10,42111969	11,48022842	47,99414444
3045	10,40677738	11,46199417	47,91971588
3050	10,39256763	11,44385338	47,84593582
3055	10,37847137	11,42580128	47,77280807
3060	10,36447906	11,40784073	47,70022964
3065	10,35059643	11,38997746	47,62823486
3070	10,33681774	11,37221241	47,55679321
3075	10,32312679	11,35454464	47,48581314
3080	10,30952644	11,33697891	47,41531754
3085	10,29601192	11,31950951	47,34527206
3090	10,28258991	11,30214596	47,27571487
3095	10,26925087	11,28487968	47,20658875
3100	10,25600147	11,26771832	47,13793945
3105	10,24283123	11,25065613	47,06971741
3110	10,22975159	11,23369884	47,00196075
3115	10,21675014	11,21683979	46,93463135
3120	10,20382786	11,20008183	46,8677063

TIME	PSGA	PSGB	WBK
3125	10,19099522	11,18342686	46,80125427
3130	10,17823887	11,16687202	46,7352066
3135	10,16556072	11,15041733	46,66957092
3140	10,15296936	11,13406563	46,60440445
3145	10,14045525	11,1178112	46,53963852
3150	10,12801743	11,10165596	46,47526932
3155	10,1156559	11,0855999	46,41130829
3160	10,10337925	11,06964493	46,34779739
3165	10,09117794	11,05378819	46,28468323
3170	10,07905102	11,03802776	46,22196198
3175	10,06699753	11,02236557	46,15962982
3180	10,05501842	11,006814	46,09768677
3185	10,04311275	10,99136734	46,03612518
3190	10,03127766	10,97602654	45,97494888
3195	10,0195179	10,96078873	45,91416168
3200	10,00783253	10,94565296	45,8537674
3205	9,996220589	10,93062115	45,79376221
3210	9,984683037	10,91568947	45,73414993
3215	9,973209381	10,9008522	45,67486954
3220	9,961812019	10,88611317	45,61598969
3225	9,950485229	10,87147045	45,55749512
3230	9,939231873	10,85692406	45,4993782
3235	9,928050995	10,84247208	45,44164276
3240	9,916932106	10,82810879	45,38423538
3245	9,90588665	10,81383991	45,32722092
3250	9,894911766	10,79966259	45,27057648
3255	9,884003639	10,78557301	45,2142868
3260	9,873165131	10,77157307	45,15835571
3265	9,862388611	10,75766182	45,10277176
3270	9,851660728	10,74382782	45,04744339
3275	9,840987206	10,73006821	44,99239349
3280	9,830360413	10,71638393	44,93759537
3285	9,819774628	10,70276737	44,88301849
3290	9,809230804	10,68922234	44,82866669
3295	9,798723221	10,67574024	44,7745018
3300	9,788259506	10,662323	44,7205658
3305	9,777832031	10,64896679	44,66682053

TIME	PSGA	PSGB	WBK
3310	9,767449379	10,63567257	44,61331177
3315	9,757110596	10,62244129	44,56004333
3320	9,746808052	10,60926723	44,50695801
3325	9,736551285	10,59615231	44,45411301
3330	9,726331711	10,58309174	44,40145874
3335	9,716146469	10,57008648	44,3490448
3340	9,705998421	10,55713463	44,29676819
3345	9,695898056	10,54425526	44,24474335
3350	9,68583107	10,53160477	44,19290924
3355	9,675786018	10,51922035	44,14120483
3360	9,665748596	10,50706387	44,08953476
3365	9,655719757	10,49511433	44,03791428
3370	9,645688057	10,48334312	43,98628235
3375	9,635660172	10,47173691	43,93466949
3380	9,625628471	10,46027279	43,88302994
3385	9,615596771	10,44893742	43,8313942
3390	9,605577469	10,43772602	43,77981949
3395	9,595563889	10,42661953	43,72827148
3400	9,585570335	10,41561699	43,67683029
3405	9,575590134	10,40470409	43,62545776
3410	9,565629959	10,39387703	43,57419205
3415	9,555682182	10,38312626	43,52302933
3420	9,545761108	10,37244987	43,47196579
3425	9,53586483	10,36184406	43,42102814
3430	9,526002884	10,35130978	43,37026978
3435	9,516166687	10,34083462	43,31965256
3440	9,506357193	10,33041573	43,26917648
3445	9,4965868	10,32005215	43,21889877
3450	9,486844063	10,30973816	43,16877365
3455	9,477134705	10,29947472	43,11882019
3460	9,467464447	10,28926373	43,06907272
3465	9,457823753	10,27909756	43,01948166
3470	9,448217392	10,26897717	42,97006989
3475	9,438652039	10,25890636	42,92088318
3480	9,429122925	10,24887943	42,87187195
3485	9,419630051	10,23889732	42,82305908
3490	9,410183907	10,2289629	42,77452469

TIME	PSGA	PSGB	WBK
3495	9,400787354	10,21907997	42,72620773
3500	9,391444206	10,20924759	42,67817688

Appendix B

Simulation of a Large Main Steam Line Break

For the simulation of a main steam line break with diameter of 14 inch (35,7 cm) and 1000 cm^2 of area, the software PCTran intended for two loop PWR was used. The simulation was conducted by using all the default parameters for this kind of reactor, with 100% of output power (600 MWe).

The initiating event number 3 (Steam Line Break Inside Containment) was selected, with a delay of 50 seconds, like is showed in the next figure.

Figure B.1 shows the window with the initiating event selection.

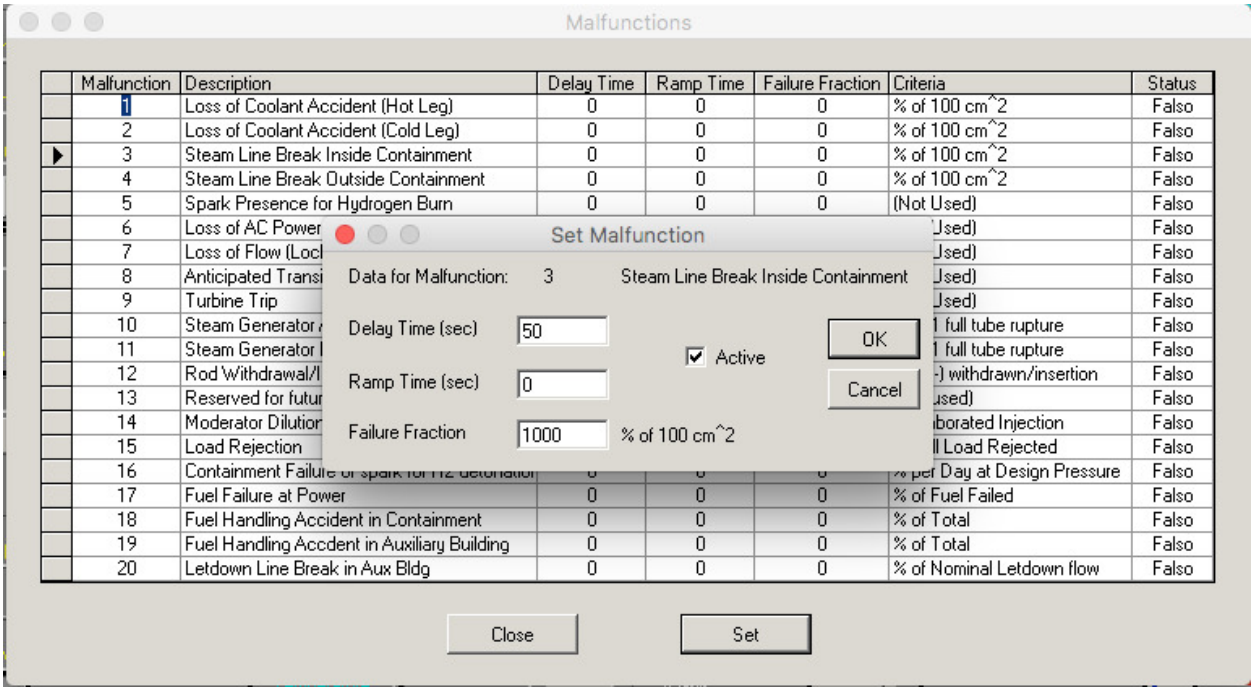

Figure B.1 - Initiating event selection.

700 seconds of simulation was analysed in this work. The same results are used later for the comparison with the results of other computer codes.

Table B.1 shows the data analysed during the 1000 cm^2 MSLB.

Table B.1 - Used data during the large MSLB.

Parameter	Units	Name
Temperature Reactor's Core average	°C	TAVG
Temperature Hot leg A	°C	THA
Temperature Hot leg B	°C	THB
Temperature Cold leg A	°C	TCA
Temperature Cold leg B	°C	TCB
Press Reactor building (bar)	bar	PRB
Pressure Steam generator A	bar	PSGA
Pressure Steam generator B	bar	PSGB
Flow Total break entering RB (t/hr)	t/hr	WBK
Press RCS	bar	P
Level SG A narrow range	%	NSGA
Level SG B narrow range	%	NSGB
Flow SG A steam	t/h	WSTA
Flow SG B steam	t/h	WSTB
Power Nuclear Flux (%)	%	PWNT

The next tables show all the results used for this analyses.

Table B.2 shows selected parameter values (set 1): P, TAVG, WSTA/B, WBK and PWNT.

Table B.2 - Selected parameter values for large main steam line break (set 1).

TIME	P	TAVG	WSTA	WSTB	WBK	PWNT
0	155	301	1773,171143	1773,171143	0	100
5	154,9535217	300,9477234	1773,171143	1773,171143	0	100,6756439
10	154,9617615	300,9631653	1773,171143	1773,171143	0	100,4497147
15	154,975296	300,9768372	1773,171143	1773,171143	0	100,2188568
20	154,9743958	300,9740601	1773,171143	1773,171143	0	100,2788391
25	154,9753113	300,9749146	1773,171143	1773,171143	0	100,2894897
30	154,9789429	300,9785461	1773,171143	1773,171143	0	100,2406311
35	154,9807739	300,9795532	1773,171143	1773,171143	0	100,2282028
40	154,9816742	300,9798279	1773,171143	1773,171143	0	100,2308807
45	154,9830322	300,9806519	1773,171143	1773,171143	0	100,222084

TIME	P	TAVG	WSTA	WSTB	WBK	PWNT
50	154,9840851	300,9811401	1773,171143	1773,171143	0	100,2161713
55	154,0636444	299,6554871	4366,561035	1554,706299	2324,719238	114,8054962
60	150,8396759	295,4628296	2088,045654	529,1141357	2330,890381	5,469744682
65	144,4539642	288,2769775	2083,342285	589,9121094	2323,557373	5,21855402
70	138,5419159	281,7743225	1988,776245	522,4919434	2229,641357	4,71499157
75	134,0929413	276,8657532	1851,38269	417,1624756	2097,051514	4,470235825
80	130,7371979	272,6697083	1722,439331	302,232605	1974,716553	4,290120602
85	127,801384	268,5336914	1836,32605	0	1819,574707	4,148823738
90	125,0464325	264,4161987	1694,205811	0	1682,244263	4,033257961
95	122,4941101	260,6991272	1578,36731	0	1567,392822	3,935916901
100	120,2248535	256,7918396	1471,504028	0	1461,025513	3,852114677
105	118,2687225	253,0770416	1378,865234	0	1371,307129	3,778736115
110	116,5003891	249,7365875	1307,627686	0	1300,639771	3,713615179
115	114,900589	246,7172699	1239,197388	0	1232,5802	3,655183554
120	113,3467712	243,9554443	1175,354492	0	1169,276611	3,602273703
125	113,1399612	243,454422	966,1404419	0	951,0405273	3,55399251
130	112,9666595	242,6719971	828,8135376	0	816,2908936	3,509644032
135	112,705574	241,7987823	719,5650635	0	710,3773193	3,468674421
140	112,4008484	240,9075317	643,2197266	0	637,2545166	3,430637121
145	112,0895767	240,042984	591,0932007	0	586,5756836	3,395166397
150	111,7803421	239,2189941	549,3392334	0	545,5040283	3,361959934
155	111,4820938	238,4440155	512,276123	0	508,7531738	3,330763817
160	111,2001801	237,7214813	479,7095642	0	476,7496338	3,301364899
165	110,9334335	237,0456848	451,7535706	0	449,1308899	3,273581028
170	110,6829605	236,4143219	426,4328613	0	423,9692078	3,247254848
175	110,5922852	235,8148499	402,2822876	0	399,9445496	3,222251654
180	110,7043381	235,2462311	380,0885925	0	378,0005188	3,198453426
185	110,8712311	234,7189026	360,0138245	0	358,0866089	3,175756931
190	111,0860748	234,2255707	341,4787598	0	339,7083435	3,154072285
195	111,241188	233,7596741	324,3735657	0	322,7320251	3,133318186
200	111,295578	233,3182526	308,4590454	0	306,9262695	3,113424301
205	111,3646545	232,8948517	293,5857239	0	292,1568909	3,094326735
210	111,4563065	232,4844818	279,9839478	0	278,6582947	3,121742487
215	111,5703201	232,088562	266,8735046	0	265,583252	3,093748569
220	111,7009277	231,7038879	254,5566864	0	253,4051361	3,066858292
225	111,8428497	231,3253174	243,5177307	0	242,4471588	3,040996075
230	111,9937439	230,9515686	233,0348358	0	232,0147858	3,016093731

TIME	P	TAVG	WSTA	WSTB	WBK	PWNT
235	112,1581726	230,5949402	223,2557373	0	222,3608856	2,992089987
240	112,3337402	230,2572327	214,8452606	0	214,0574646	2,968928814
245	112,5182877	229,9367828	207,0756378	0	206,3047333	2,946558714
250	112,7118378	229,6313477	199,4430084	0	198,6913452	2,924933195
255	112,9138565	229,3395691	192,0487061	0	191,3250732	2,904008627
260	113,123909	229,0600586	184,9598541	0	184,269989	2,883746147
265	113,3414307	228,7914124	178,2297668	0	177,5779572	2,864109516
270	113,5659714	228,5323639	171,8960419	0	171,286087	2,84506464
275	113,7971497	228,2818298	165,9811249	0	165,4122162	2,826580763
280	114,0319519	228,0361176	160,4764252	0	159,948288	2,808629274
285	114,2667313	227,7909088	155,3736267	0	154,8848572	2,791182995
290	114,5015488	227,5466614	150,7963409	0	150,3726196	2,774217606
295	114,7366791	227,3038177	146,7828979	0	146,4051056	2,75770998
300	114,9723282	227,0628052	143,1631012	0	142,818573	2,741638422
305	115,2089005	226,8243103	139,8401337	0	139,5193634	2,725982904
310	115,4464569	226,5882568	136,7127686	0	136,4111481	2,710724831
315	115,6847	226,3541718	133,7883148	0	133,5069733	2,695846319
320	115,9236908	226,1222839	131,0640564	0	130,8023987	2,681331158
325	116,1635513	225,8927002	128,5330048	0	128,2916718	2,66716361
330	116,4042969	225,6654053	126,2002335	0	125,9766235	2,653328896
335	116,6462326	225,4404297	124,0402145	0	123,8333282	2,639814138
340	116,8914948	225,2175903	122,0431213	0	121,8519821	2,626605749
345	117,1403503	224,9967194	120,1989822	0	120,0225906	2,613691807
350	117,3928299	224,7775879	118,498024	0	118,3362656	2,601060629
355	117,6489639	224,5599823	116,9575806	0	116,812294	2,588701725
360	117,9087982	224,3437958	115,5673294	0	115,4354782	2,576604605
365	118,1705704	224,1288605	114,3012543	0	114,1807098	2,564759731
370	118,4325485	223,9150238	113,1404572	0	113,0295944	2,553157806
375	118,6946793	223,702179	112,0708237	0	111,9684296	2,54178977
380	118,9569244	223,4902496	111,0811157	0	110,9860764	2,530647993
385	119,2192459	223,2791595	110,1603317	0	110,0717697	2,519724131
390	119,4815826	223,0688019	109,3020554	0	109,2194977	2,509010792
395	119,7439194	222,8592072	108,5011826	0	108,4236832	2,498500824
400	120,0062561	222,6503448	107,7501907	0	107,6779556	2,488187551
405	120,2685318	222,4420624	107,0502472	0	106,9829178	2,478064775
410	120,5307083	222,2343292	106,397789	0	106,335022	2,46812582
415	120,7930984	222,0271301	105,7895966	0	105,7306137	2,458365202

TIME	P	TAVG	WSTA	WSTB	WBK	PWNT
420	121,0578537	221,8205414	105,2184677	0	105,1635742	2,44877696
425	121,3253098	221,6144714	104,6869125	0	104,6358261	2,439356327
430	121,5955353	221,4088898	104,192215	0	104,1446457	2,430097342
435	121,8685913	221,2037506	103,7303925	0	103,6854095	2,420995712
440	122,1444397	220,9991455	103,2943878	0	103,2524567	2,412046909
445	122,4205933	220,7948761	102,893074	0	102,8552322	2,403245926
450	122,6964645	220,5909119	102,526268	0	102,4909744	2,39458847
455	122,9720612	220,3872528	102,1839447	0	102,1506195	2,386070967
460	123,2476044	220,1839447	101,8616409	0	101,8306961	2,377688885
465	123,524765	219,9809113	101,5625305	0	101,5338364	2,369438887
470	123,8053894	219,7765503	101,284996	0	101,2583466	2,361316919
475	124,0889587	219,5694885	101,0257034	0	101,0004807	2,353319645
480	124,3755798	219,3597565	100,7813644	0	100,7578659	2,345443726
485	124,6653442	219,1472931	100,5534515	0	100,5314941	2,337685823
490	124,9578629	218,9320984	100,3400955	0	100,3194962	2,330043316
495	125,2500916	218,7143097	100,1366882	0	100,1169205	2,322512388
500	125,5398254	218,494278	99,94435883	0	99,92575073	2,315090656
505	125,8266983	218,2719269	99,76316071	0	99,74559784	2,307775259
510	126,1107025	218,047226	99,59140015	0	99,5743103	2,300563335
515	126,3918762	217,8201141	99,42481232	0	99,40864563	2,293452978
520	126,6706848	217,5916748	99,26692963	0	99,25159454	2,286440611
525	126,9481277	217,3632507	99,11716461	0	99,10260773	2,279524803
530	127,2240601	217,1346741	98,97294617	0	98,95874786	2,272702456
535	127,4981461	216,9059601	98,83460236	0	98,82119751	2,265972137
540	127,8074341	216,6779022	98,70401001	0	98,6913681	2,259330988
545	128,2461853	216,4546051	98,58039856	0	98,56815338	2,2527771
550	128,6837158	216,2318115	98,46199036	0	98,45063782	2,246308804
555	129,1222382	216,0096741	98,35208893	0	98,34152985	2,239923477
560	129,5563049	215,7882233	98,24617767	0	98,23600006	2,233619928
565	129,9848785	215,5673828	98,14784241	0	98,13842773	2,227396011
570	130,4081726	215,347229	98,05420685	0	98,04508209	2,221249819
575	130,829834	215,1278381	97,96624756	0	97,9578476	2,21517992
580	131,2514496	214,9093475	97,88380432	0	97,87561798	2,209184408
585	131,6730957	214,6918335	97,80511475	0	97,79762268	2,203261614
590	132,0923157	214,4750977	97,73297882	0	97,72563934	2,197410345
595	132,5062103	214,2592316	97,66259766	0	97,65589905	2,191628695
600	132,9149017	214,0442505	97,59832764	0	97,59220886	2,18591547

TIME	P	TAVG	WSTA	WSTB	WBK	PWNT
605	133,3196106	213,8303375	97,53697205	0	97,5309906	2,18026948
610	133,724823	213,6176758	97,47962189	0	97,47418213	2,174688578
615	134,1310425	213,4063721	97,42672729	0	97,42137146	2,16917181
620	134,5382996	213,1964874	97,37568665	0	97,3708725	2,163717985
625	134,9423065	212,9878693	97,32990265	0	97,32559204	2,158326149
630	135,3414001	212,7805939	97,28514099	0	97,28091431	2,152994394
635	135,735611	212,5745544	97,24503326	0	97,24127197	2,147722006
640	136,125	212,3697968	97,20728302	0	97,20355988	2,142507315
645	136,5096436	212,1662903	97,17211151	0	97,16884613	2,137349606
650	136,8895264	211,963974	97,14128876	0	97,13798523	2,132248163
655	137,2648163	211,7629089	97,11019897	0	97,10733032	2,127200842
660	137,6404877	211,5630798	97,08335876	0	97,0809021	2,122207642
665	138,0194092	211,3646393	97,05804443	0	97,05551147	2,117266893
670	138,4018555	211,1675415	97,0345459	0	97,03240967	2,112378359
675	138,7868805	210,9717712	97,01433563	0	97,01209259	2,107539892
680	139,1677246	210,7771454	96,99375153	0	96,99192047	2,102751732
685	139,5435181	210,5834961	96,97683716	0	96,97531128	2,098012447
690	139,9143066	210,3907928	96,96035767	0	96,95872498	2,093321085
695	140,2801208	210,1989594	96,94543457	0	96,94409943	2,088677168
700	140,6409302	210,0078888	96,93289948	0	96,9313736	2,084079266

Table B.3 shows selected parameter values (set 2): THA/B, TCA/B and PSGA/B.

Table B.3 - Selected parameter values for large main steam line break (set 2).

TIME	THA	THB	TCA	TCB	PSGA	PSGB
0	319,6812134	319,6812134	282,3187866	282,3187866	55,00490952	55,00490952
5	319,6324463	319,6324463	282,3208618	282,3208618	55,03476715	55,03476715
10	319,5959778	319,5959778	282,3305054	282,3305054	55,04924011	55,04924011
15	319,5953674	319,5953674	282,3440552	282,3440552	55,06443024	55,06443024
20	319,5907898	319,5907898	282,3554688	282,3554688	55,07528305	55,07528305
25	319,5839539	319,5839539	282,3635559	282,3635559	55,08174515	55,08174515
30	319,5821228	319,5821228	282,3697205	282,3697205	55,08676147	55,08676147
35	319,581543	319,581543	282,3745422	282,3745422	55,0907135	55,0907135
40	319,5801392	319,5801392	282,3779602	282,3779602	55,09337234	55,09337234
45	319,5792236	319,5792236	282,3804016	282,3804016	55,09526062	55,09526062

TIME	THA	THB	TCA	TCB	PSGA	PSGB
50	319,5789185	319,5789185	282,3821716	282,3821716	55,09668732	55,09668732
55	322,9758606	318,8793335	278,2541199	282,350647	44,21592331	55,50308609
60	323,5317383	314,0389709	273,8421631	283,3348389	45,36389542	59,88089371
65	316,7507629	305,1310425	271,1209717	282,7406311	45,00575638	60,79240036
70	308,098175	295,2805176	267,6960449	280,5135803	43,1535759	59,65288162
75	299,1931458	286,1442566	265,0721436	278,1210327	40,62985992	58,05996704
80	292,5192566	279,2290039	262,0081177	275,2983704	38,34540558	56,47232056
85	287,8551331	273,5984497	257,8966064	272,1532898	35,33156967	55,92089462
90	283,3480835	268,5156555	253,854187	268,6865845	32,82734299	55,50498962
95	278,630127	263,9377441	250,5275574	265,2199402	30,68297005	54,86742401
100	275,6300964	259,4656067	245,772644	261,9371338	28,69005013	54,05957794
105	271,7369995	255,1479187	241,9634857	258,5525513	27,05658722	53,05804062
110	267,4317627	251,1967926	239,021225	255,2561951	25,73620224	51,88845825
115	263,2750854	247,6569672	236,5343628	252,1524506	24,46485901	50,58585739
120	258,7886353	244,4875031	234,9515381	249,2526855	22,86523628	49,17993546
125	252,8554077	242,527359	236,9793091	247,3073425	18,98967934	47,82074356
130	250,340332	241,4134064	237,102478	246,0293884	16,49566841	46,60964584
135	248,9025726	240,5532227	236,5831757	244,9325256	14,55594349	45,44577026
140	247,7163696	239,7570496	235,9197693	243,8790894	13,23585796	44,3288269
145	246,5807037	238,9892578	235,2667236	242,8581696	12,30615139	43,25831604
150	245,4574127	238,2494202	234,6678467	241,875824	11,54475403	42,23457336
155	244,3646545	237,5442963	234,12146	240,9418335	10,85985661	41,28564835
160	243,3216705	236,8742371	233,6204224	240,0678406	10,26825237	40,44558716
165	242,3428192	236,2416687	233,152771	239,2539215	9,755313873	39,65066528
170	241,4245148	235,6495972	232,7172394	238,4921875	9,285396576	38,88357544
175	240,5621796	235,0957642	232,3098145	237,7762299	8,836815834	38,14585876
180	239,7424011	234,5696411	231,9237213	237,0964661	8,42885685	37,43771744
185	238,9707184	234,0775909	231,563858	236,4570007	8,057049751	36,75985718
190	238,2562561	233,6199493	231,2211609	235,8574677	7,714018345	36,11268616
195	237,5904083	233,191925	230,8950806	235,2935791	7,39689064	35,49592209
200	236,9636383	232,7879944	230,5852661	234,7609253	7,101481438	34,91173935
205	236,4294739	232,3853607	230,2314453	234,2755585	6,825613499	34,38269424
210	235,972641	231,9772949	229,8348999	233,8302307	6,573197842	33,90034485
215	235,5574646	231,5735626	229,4283447	233,412262	6,327688217	33,44980621
220	235,1697998	231,1778259	229,0215454	233,0135193	6,101289272	33,01429749
225	234,8097076	230,7893219	228,6078949	232,6282654	5,896282673	32,59266281
230	234,4541626	230,4093781	228,203064	232,2478333	5,700848579	32,18439484

TIME	THA	THB	TCA	TCB	PSGA	PSGB
235	234,0327148	230,0625305	227,8842926	231,8544922	5,521632195	31,78926086
240	233,5908966	229,742569	227,617218	231,4655151	5,367220402	31,41022873
245	233,1564636	229,4431458	227,3768005	231,0901184	5,221540928	31,04545403
250	232,7390289	229,1615601	227,1520386	230,7295074	5,078635693	30,6952095
255	232,3408051	228,8938446	226,9379578	230,3849182	4,940357208	30,35855293
260	231,9617157	228,6385345	226,7320099	230,055191	4,808083534	30,03245926
265	231,6005249	228,3941956	226,5326233	229,7389526	4,682770252	29,71879387
270	231,2559052	228,159256	226,3384857	229,4350891	4,564986229	29,41741562
275	230,9263611	227,9324646	226,1486511	229,1425171	4,454957008	29,12785721
280	230,6097412	227,7185669	225,9615479	228,8527374	4,352690697	28,85315323
285	230,3017273	227,5134277	225,7737732	228,5620728	4,258051872	28,59583473
290	229,9998474	227,3090363	225,583847	228,2746582	4,174261093	28,35405922
295	229,7034302	227,1029205	225,3915405	227,9920502	4,100324631	28,12733078
300	229,4122772	226,8941345	225,1971893	227,715332	4,033224106	27,91821671
305	229,1265259	226,682785	225,0014648	227,4452057	3,971372843	27,72419548
310	228,8475037	226,469696	224,8037415	227,1815796	3,913100004	27,542799
315	228,5749512	226,255188	224,6039124	226,9236755	3,858701468	27,37168503
320	228,3074646	226,0398865	224,4032288	226,6708069	3,80807519	27,209198
325	228,0446777	225,8244019	224,2023315	226,4226379	3,761081457	27,05420303
330	227,7862854	225,6091003	224,0015869	226,1788025	3,717523575	26,90576935
335	227,532135	225,3944092	223,8011932	225,9389496	3,67720437	26,76239586
340	227,2820282	225,1807556	223,6012726	225,7025146	3,639936447	26,62234497
345	227,0356445	224,9683228	223,4017944	225,4691315	3,605530262	26,48540497
350	226,7926941	224,7570496	223,2027588	225,2384644	3,573843956	26,35139656
355	226,5529327	224,546814	223,0040588	225,0101929	3,545256376	26,22013855
360	226,3159637	224,3375244	222,8056488	224,7841339	3,519403458	26,0914669
365	226,0815887	224,1290131	222,6075134	224,5600739	3,495824337	25,96520996
370	225,8495178	223,9212036	222,4095764	224,3378906	3,474181414	25,84121895
375	225,6195068	223,7139435	222,211731	224,1172638	3,454221249	25,71933937
380	225,3914185	223,5072174	222,0140533	223,8982239	3,435733795	25,59943581
385	225,1650696	223,3009186	221,8164063	223,6805573	3,418521404	25,48137093
390	224,9403381	223,0950317	221,6188965	223,4641571	3,402475357	25,36502075
395	224,7180481	222,8894958	221,4204407	223,2489624	3,38748312	25,25026703
400	224,4979248	222,6843414	221,2212982	223,0348816	3,37344408	25,13700104
405	224,2780609	222,4794769	221,0233307	222,8218994	3,360359192	25,0251236
410	224,0589447	222,2748718	220,8258057	222,6099091	3,348161697	24,91453934
415	223,8414154	222,0704803	220,6278534	222,3987732	3,336773872	24,80515671

TIME	THA	THB	TCA	TCB	PSGA	PSGB
420	223,6261139	221,8664246	220,4288177	222,1884766	3,326100111	24,69689751
425	223,4106598	221,662674	220,2310181	221,9790192	3,316166401	24,58968544
430	223,195694	221,4591827	220,0337982	221,7703094	3,306919575	24,48345184
435	222,9820404	221,2559662	219,8361969	221,5623322	3,298261881	24,37812996
440	222,7704315	221,0530548	219,637619	221,3550262	3,290110588	24,27366257
445	222,5584564	220,8503876	219,4402771	221,1483459	3,282511234	24,16999245
450	222,3467255	220,6479034	219,2434082	220,942215	3,275410891	24,06706429
455	222,136322	220,4455719	219,0458527	220,7365875	3,268752813	23,96482658
460	221,9272461	220,2434387	218,8476563	220,5314331	3,262489557	23,86323166
465	221,7179108	220,0414581	218,6503448	220,3267822	3,256660461	23,76223946
470	221,5197144	219,8380432	218,4414825	220,1231537	3,251233339	23,66178894
475	221,3311615	219,6317902	218,2198639	219,9192352	3,246128082	23,56173325
480	221,144928	219,4225159	217,9914398	219,7138367	3,241318226	23,46192169
485	220,9578857	219,2100677	217,7587738	219,5065918	3,236812592	23,36222267
490	220,7697296	218,9943848	217,5219269	219,297287	3,232576132	23,2625103
495	220,5825806	218,7754517	217,2786713	219,0858307	3,228508234	23,16267014
500	220,3933716	218,5535583	217,0325775	218,8724365	3,224663258	23,06261253
505	220,2028046	218,3288116	216,7831268	218,6571808	3,221024275	22,96226311
510	220,0124207	218,1011963	216,5288391	218,4400635	3,217543364	22,86155128
515	219,8223267	217,8707428	216,2694855	218,2210999	3,214177132	22,76040268
520	219,6191101	217,6394196	216,0189972	217,998703	3,210972071	22,65898514
525	219,3968048	217,4124146	215,7857666	217,7701721	3,207919836	22,55883217
530	219,1689606	217,1870575	215,5571136	217,5390167	3,204956055	22,46011543
535	218,9375	216,9619446	215,3315887	217,3071289	3,202120781	22,36266708
540	218,7042389	216,7366638	215,1077271	217,0753021	3,199430704	22,26634789
545	218,4740753	216,5136566	214,8854065	216,8458405	3,196860313	22,17116356
550	218,2462463	216,2925262	214,6647186	216,6184235	3,194406033	22,07709694
555	218,0188904	216,0723419	214,4458618	216,3924103	3,19210124	21,98404312
560	217,7940369	215,8527222	214,2262268	216,1675415	3,189873457	21,89192963
565	217,5684052	215,6335297	214,0087891	215,9436646	3,187795162	21,80067253
570	217,3451691	215,4147949	213,7903595	215,7207184	3,185788393	21,71021271
575	217,1214905	215,1965485	213,5737457	215,4986725	3,183904886	21,62048721
580	216,8994598	214,9789429	213,357132	215,2776184	3,182107687	21,53145218
585	216,6781158	214,7621002	213,1415863	215,0576019	3,180398941	21,44306946
590	216,4574127	214,54599	212,9271851	214,8386078	3,178794861	21,35532761
595	216,2385712	214,3305206	212,7125702	214,6206207	3,177241802	21,26891708
600	216,0192719	214,1155396	212,5001373	214,4038544	3,175802708	21,18407631

TIME	THA	THB	TCA	TCB	PSGA	PSGB
605	215,8026276	213,9011078	212,286911	214,188446	3,174401522	21,10061646
610	215,5859985	213,6874084	212,0759125	213,9745026	3,173092365	21,01838493
615	215,37117	213,4746704	211,8655396	213,7620392	3,171849489	20,93726158
620	215,1579132	213,263031	211,6562958	213,5512238	3,170660019	20,85715485
625	214,9452972	213,0525055	211,4491119	213,3418732	3,169559479	20,7779789
630	214,7355194	212,8431396	211,241684	213,1340485	3,168479681	20,69965363
635	214,5256042	212,6349487	211,0369873	212,9276123	3,167494297	20,62205315
640	214,3184052	212,4279327	210,8321228	212,7225494	3,166537046	20,54498291
645	214,1116943	212,2221985	210,6293335	212,5187836	3,165644884	20,4684124
650	213,9060974	212,0176544	210,4278107	212,3162842	3,164816141	20,39232445
655	213,7028656	211,8143311	210,2264404	212,1150055	3,16400075	20,31669426
660	213,4995728	211,6122131	210,0276031	211,9149628	3,163264036	20,24151421
665	213,2990723	211,4114227	209,8285065	211,7161713	3,162539244	20,16677475
670	213,0991364	211,2120209	209,6316071	211,5187073	3,16186595	20,09245872
675	212,9007568	211,0139923	209,435791	211,3225555	3,161236048	20,01856422
680	212,7042542	210,817215	209,2406158	211,1276703	3,160618305	19,94496918
685	212,5077209	210,6216888	209,04776	210,9337921	3,160067081	19,87124634
690	212,3139496	210,4273376	208,8541412	210,7407684	3,159507275	19,79738617
695	212,1200256	210,2340851	208,6625671	210,5485382	3,158993006	19,72343826
700	211,9272461	210,0418243	208,4715881	210,3569946	3,158505678	19,64943886

Appendix C

Power Related to the Decay Heat Calculation

To estimate the power related to the decay heat along 100 days in an 1800 MW reactor that was operating 1 year before her shutdown, the next expression was used [3], [6], [7].

Power related to the decay heat (MWt) = P_t*0,066*(T $^{(-0,2)}$ - (T+T_b) $^{(-0,2)}$)

P_t - Thermal power = 1800 MWt

T_b - Seconds of plant operation before shutdown = 31536000 seconds

T - Time

A year of 365 days, was considered before shutdown.

Number of seconds: 60*60*24*365 give 31536000 seconds .

Table C.1 shows approximate values of power related to the decay heat.

Table C.1 – Power related to the decay heat .

Time (Days)	Time (Seconds)	Power Related to the Decay Heat (MWt)
0,00001	0,864	118,5657174
0,0001	8,64	73,42273398
0,001	86,4	44,93943881
0,01	864	26,96771189
0,1	8640	15,62849243
1	86400	8,475662033
10	864000	3,97957194
100	8640000	1,288673922