AN ACCELEROMETER-BASED APPROACH TO HULL MONITORING BEYOND THE ELASTIC REGIME

by

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Abstract

With the efficient shipping route offered by the Northwest Passage, and its rapidly increasing availability to a wider range of ships in the coming years, the prevalence of ice covered waters to ships will be greatly increased. An option for hull-monitoring is explored which allows for damage detection beyond the elastic regime and deep into the plastic regime. This method involves using an accelerometer placed on the inside of the hull, and as an impact causing plastic damage is experienced, accelerometer readings are used to determine the delivered force to the hull. In this thesis a proof of concept for the suggested method is described and shown through a simplified example using finite element analysis. In this proposed method, the accelerometer allows for the structure to be examined from the point of view of the equation of motion. The proposition requires numerical integration from the acceleration data to find the displacement of the damaged area, and calibrations done in finite element analysis for both the stiffness and mass parts of the equation of motion to calculate the delivered force to the hull. The average error at which the proposed model determines force was found to be approximately 7%, which was calculated within the range of plastic flow behavior of the structure during an impact. Further development of this proposed method could have significant benefits such as increased safety for those at sea, better operational awareness of a ship's capabilities, reduced dry-docking and inspection frequency, and the collection of realistic data from significant ice collisions at sea.

Acknowledgements

I would like to thank a number of people, without whom I would not have come near to completing this research or my master's degree. It is important to understand that this research would not have been possible alone, and it instead is a result of the outstanding people in my life who helped me along the way.

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Chapter 1 Introduction

1.1 Objectives and Scope

1.1.1 Background

Internationally, shipping is responsible for 90% of world trade (United Nations Business 2020). As internationalization in trade continues to grow and demand continues to increase, shipping will also expand and ways to improve its efficiency will be explored. An often-considered possibility in shipping routes is what is known as the Northwest Passage, which allows for a quicker link between the Pacific and Atlantic Ocean. This route is viable for some ships during 2 months of the year, when ice fields are clear enough for safe passage. Studies have shown that the summer sea-ice extent is currently about 5 million km^2 and is decreasing about 79 000 km^2 each year (Herrmann 2019). Though, as Arctic ice continues to disappear, safe passage for a wider range of ships will become more feasible in the near future. Some estimates predict that the Northwest Passage will “become substantially more accessible by 2040–2059” (Smith and Stephenson 2013, 1).

For ice-strengthened ships, this voyage does not present as high a risk when compared to a non-ice classed ocean-going ships. A problem arises when ships that are not ice-classed are in a circumstance where they must go into ice-infested waters. This occasionally is necessary as emergencies present themselves; for sudden rescue duties in the event of a nearby vessel in need, for the demands of national security in arctic conditions, or even other assignments that require an urgent presence in ice-covered waters. There are significant risks when it comes to ship collisions with ice, especially when dealing with multi-year or old ice in an Arctic environment. Ice impacts can result in significant damages to a hull and even at a moderate cruising speed, structural failure can occur unexpectedly. However, it is without doubt that the prevalence of ships in the Arctic will grow as shipping routes expand north. An overview of anticipated shipping routes through the Arctic Ocean is given in Figure 1.1.

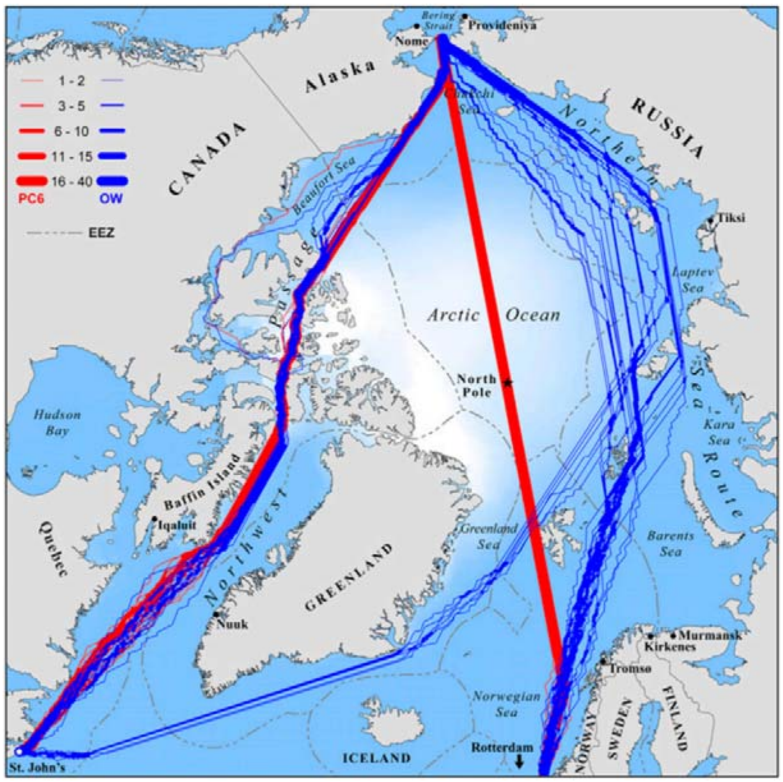

Figure 1.1: Prediction of possible shipping routes through the Arctic Ocean during minimal ice season by 2040. Routes shown in red for ice-strengthened Polar Class 6 (PC6) vessel, and in blue for conventional open-water (OW) ship (Smith and Stephenson 2013).

With more ships operating in this dangerous environment, damage will surely be more prominent and so will the need for inspection and repair. As these costs can be exceptionally high, it would suggest that a method of load detection and profiling would be of great interest. Having the ability to detect a load the instant it happens, and have detailed information about its magnitude, the incurred damage profile, and the extent to which the hull can now withstand would be a tremendous aid to any ship operator. This system would permit the owner to make assessments as to whether the ship can continue to sail, if a dry-docking will be needed, or if there is no immediate cause for concern. Possessing a tool that gives ship operators confidence in inferring the condition of their hull after a collision can have unprecedented advantages. A method of hull monitoring, as such, is described and demonstrated with a proof of concept in this thesis.

Additionally, ice-classed ships also have something to gain from this proposed system. Given current regulations regarding design ice loads for ice-strengthened ships, more accurate information concerning actual ice load magnitudes can be highly valuable. This can be of great benefit to regulators as designing for ice loads can be done more accurately and reliably, and the amount of plastic damage that can be safely tolerated can be better understood. Also, a practical implication that benefits the ship operators is a better general understanding of the capability of the ship; safety is increased as this system would allow for the ship operator to know whether the ship can be operated more or less aggressively.

1.1.2 Research Goal

A solution which will be investigated in this thesis is a hull-monitoring system which is capable of measuring the force on a hull structure beyond its elastic limit. A hull-monitoring system that measures stress into the plastic regime would give crucial insight into the state of the hull structure while at sea, as simply knowing the true state of the hull is greatly beneficial. This concept would add to the existing state of the art technology used in the industry and in research today, as no current solution offers monitoring beyond elastic response.

In theory, this method of hull "sensing" uses accelerometers and therefore only acceleration data as an input into the system. From there, using a model developed in Finite Element Analysis (FEA) which is calibrated for expected, realistic impact events, the stress on the hull would be the output from the system.

For the purpose of this thesis, the arrangement and technique of the calibrated Finite Element Models (FEM), mathematical functions, and calculations which form the complete proposed system will be referred to as the "Model" for simplicity. The goal is to first develop the methodology for, and calibrate the Model using FEA, and then to perform a validation of the Model.

1.1.3 Purpose of Work

The purpose of the research and work conducted in this thesis is to fill a gap in the existing technology available for ship structural sensing. Through research discussed in Chapter 2.5 Existing State of the Art, most solutions to hull-monitoring only provide information regarding the state of the hull in its elastic response regime, for loads that result in relatively small deflections. While this can be useful information for determining fatigue life and global hull loads, an extension on the existing technology is needed. The method introduced in this thesis can provide the necessary framework needed for handling loads beyond the small deflection limitation. As discussed in Chapter 1.1.1 Background, the need for such a system is growing and has a likelihood of becoming a necessity in the near future.

1.1.4 Hypothesis of Results

The method and technology explained in this thesis is a proof of concept for its current objective. This means that through computer-based validation, the method outlined accurately determines the force on a structure that causes a plastic response, or permanent damage. With further research and expansion, this method of hull-monitoring can potentially be used by ships at sea. The hypothesis for a final product, after further research, is that the technology can be equipped to a ships hull as a system and be able to accurately, and instantly provide details to the ship operator regarding the damage incurred to the hull, and a profile of the damage immediately following a collision.

Chapter 2 Literature Review

To begin to describe the proposed system of hull-monitoring, background information will be discussed, as necessary. To form a base of underlying knowledge required to understand the concepts discussed in the development of the Model, subject areas explained in greater detail include aspects of material mechanics, finite element modelling and analysis, and harmonic motion. Topics are discussed in detail sufficient for the understanding of the Model development.

To best understand the significance and value the proposed system in this thesis has, an extensive search for existing technology in this field has been conducted. It should be noted that the method proposed in this thesis is the first of its kind and thus there is no direct comparison to be made with an already established system in either research or commercial use. Furthermore, research concluded that there is currently no existing technology or instrument which can accurately monitor plastic damage/ permanent deformation of a hull in the shipping industry. Focus has instead been directed toward existing technology used in both research and commercial applications for other hull-monitoring systems. It can be concluded that current systems available have the capability to measure local elastic strain and global motions of a hull, as explained further in this chapter.

During this review, the objective will be to explain the mechanics of the hull monitoring system, understand its function, and determine its accuracy of results. Particularly, it is of interest to understand the effectiveness of the system discussed in each application. This opportunity will also be used to examine noted sources of error and highlight, wherever possible, areas for improvement.

2.1 Material Mechanics

A brief overview of the mechanics of material behavior is provided to help understand the author's proposed method of hull monitoring. Given a structure of ductile material that is supported, no matter the complexity or geometry, when experiencing an external force it will first respond elastically and then plastically until fracture, provided there is sufficient external force. In the elastic regime of structural response, no permanent damage has been inflicted and the structure will spring back to its original state if the external force is removed. As discovered by Robert Hooke, Hooke's Law states that the displacement of the deformation of an object is directly proportional to the deforming force (The Editors of Encyclopaedia Britannica 2006). This is true until the point of yield is reached, at which point the structure will begin to experience permanent deformation which cannot be reversed. Plasticity can be defined as a solid which may sustain permanent deformations when completely unloaded (Souza Neto, Peric and Owen 2008). An example of a stress-strain relationship for an experimental specimen subjected to a uniaxial load is given in Figure 2.1.

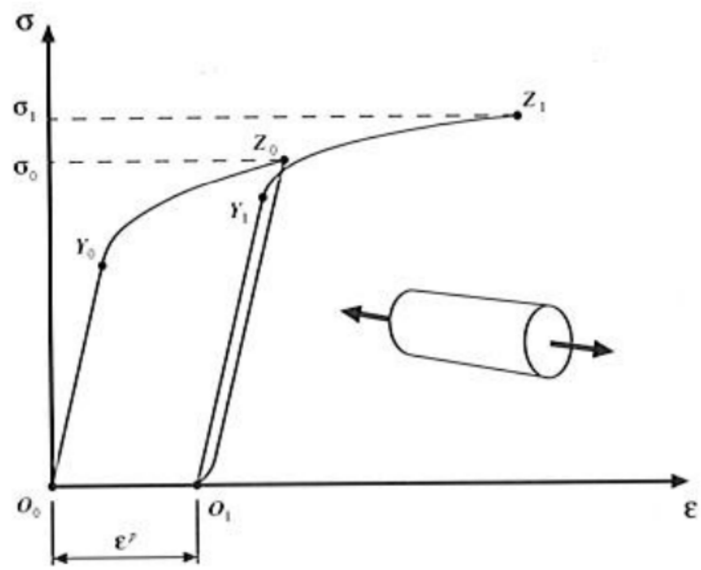

Figure 2.1: Example stress-strain relationship for uniaxially loaded specimen (Souza Neto, Peric and Owen 2008).

If a specimen is loaded uniaxially up to a stress of Y_0 then it will return to its initial state of strain, O_0. Though, when load is applied beyond Y_0 and to an arbitrary Z_0, the specimen will be permanently deformed at a strain of O_1. If a load were to be applied afterwards then the specimen would deform elastically at the same stress-strain rate, Young's Modulus (The Editors of Encyclopaedia Britannica 2019), as before. This is until a load greater than Z_0 is applied thus causing greater plastic deformation. For reasons later discussed this thesis, it is also important to understand the concept of plastic flow. This is the state of the specimen after it has first reached yield and is loaded further; plastic flow is the occurrence of increasing plastic strain (Souza Neto, Peric and Owen 2008).

2.2 FEA

2.2.1 General Overview

Finite Element Analysis (FEA) is a method of calculating precise approximations to complex problems using numerical simulation. This method finds approximate solutions within a tolerance limited by only by the level of input detail provided by the user, and computing power. FEA is widely used in the engineering industry as a tool for estimating operational loads on a structure, internal stresses in a part, or any other problem which is too complex or does not have an analytical solution. FEA works by discretizing the user-defined structure into many small parts known as elements that have finite dimensions and properties, which are also assigned by the user (Quinton 2019a).

In order to create a fully functioning finite element model (FEM), the user must define a number of parameters regarding their model. These parameters include element choice, mesh, material, boundary conditions, application of loads, and solution controls (Quinton 2019a).

2.2.2 Explicit and Implicit FEA

FEA uses numerical integration to produce approximations of solutions, and in doing so there are two approaches that can be used depending on the problem. Explicit FEA is best used for problems that happen quickly – are transient and dynamic, medium-high frequency – while implicit FEA is well-suited for static, quasi-static or low-medium frequency steady-state dynamic problems (Liu and Quek 2013).

When using explicit FEA solutions at the next time step are functions of solutions at the current time step. While explicit time integration will only be stable when the time step value is very small its accuracy increases as the time step size decreases. This supports good accuracy for simulating dynamic effects and fast-acting problems because many time steps are calculated over a relatively short duration (Quinton 2019b).

Implicit FEA has many forms and each are best used for different scenarios, and to summarize there is dynamic (time-dependent) and static (time-independent) implicit FEA. For the research discussed in this thesis, static implicit FEA is used, meaning that Hooke's Law, equation [1], is the governing equation and simulations conducted are independent of time (Quinton 2019b).

$$F = kx \qquad [1]$$

The subject of explicit and implicit numerical integration will be later referred to in Chapter 4.2 Procedure for Creating Model, and a description of their functions and differences is required for general understanding.

2.3 Equation of Motion for a system in Harmonic Motion

For a single degree-of-freedom system (SDOF; one degree-of-freedom, 1DOF) undergoing harmonic motion, the equation used to understand its motion and excitation relates its mass, stiffness, and its ability to dissipate the energy. This means that for a system with one possible direction of movement that is given an excitation via an external force, the equation of motion given in equation [2] (Peacock and Hadjiconstantinou 2007), is what governs its vibration. Harmonic motion simply describes the simplest form of periodic motion, where the restoring force is proportional and opposite to displacement of the body (Moro 2016).

$$F = ma + cv + kx \qquad [2]$$

In the equation of motion, equation [2], the variables represented are as follows:

- F; applied external force, N
- m; mass of the body, kg
- a; acceleration experienced by the body, m/s^2
- c; the objects ability to dampen the motion, given as a damping coefficient, kg/s
- v; speed of the body, m/s
- k; stiffness, kg/s^2
- x; amount the body is displaced, m

A simple case of a SDOF system is shown in Figure 2.2.

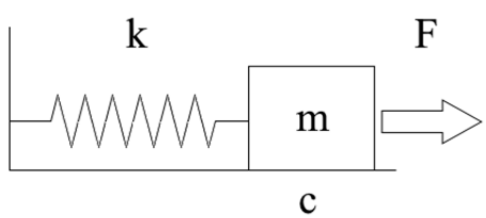

Figure 2.2: One degree-of-freedom represented by a simple mass-spring system.

In simple SDOF systems like this one, the mass is treated as a rigid body which means it cannot bend or deform, the systems elasticity is idealized with a single value represented by the single spring, and the system has only one natural frequency (Moro 2016). Often times complex real-world systems can be simplified as a SDOF system, as it allows for easy inspection and calculations. This idea is used the theory of the proposed model discussed in this thesis, as the use of an accelerometer allows only for one measurement of acceleration. This means that for measurements taken with a single accelerometer, the point on the body where the measurement is taken can effectively be viewed as a SDOF.

2.4 Types of Ship Loading

As later discussed in Chapter 2.5 Existing State of the Art, hull structural monitoring can be used to observe a variety of ships structure aspects that result for a variety of reasons. Ships can suffer damage from one or many of several possible load scenarios when in operation. Depending on the purpose of the ship, a hull monitoring system should be designed in preparation for the loading types that it is expected to encounter. As defined by Phelps and Morris (Phelps and Morris 2013), the load types experienced by ships can be divided into six categories:

1. Static loads
2. Low frequency dynamic loads
3. High frequency dynamic loads
4. Impact loads
5. Operational loads
6. Thermal loads

Static loads on ships include the weight of all equipment onboard and the counteracting buoyancy force acting upwards. Major components “such as the ship’s structure, machinery, outfit, fuel and cargo are not distributed uniformly along the length of the ship" (Phelps and Morris 2013, 2), and the difference created by changing the positions of onboard equipment and refilling fuel capacities can cause fatigue over its lifespan. Also, it makes a big impact on the occurrence of fracture in the structure, as crack growth rate is dependent on the mean stress level (Phelps and Morris 2013).

Low frequency dynamic loads primarily involve the ocean waves that act on the ship. This causes pressure fluctuations at a low frequency and results in inertial reactions by the ship as its mass is shifted continuously. This low frequency motion is a large contributor to the fatigue life of the hull and in worst case scenarios it has resulted in hull structural failure. Hull monitoring can provide for an accurate history of stress cycles in the structure and can help in determining the fatigue life of the hull. This is often highlighted as the main benefit of having a hull structural monitoring system today (Phelps and Morris 2013).

High frequency dynamic loads can result in major fatigue damage or expedited failure of a structural component of the hull, especially when the vibratory response of the structure is near a major natural frequency. Loads which can cause this response can include springing after wave slamming or large equipment or machinery which are required to rotate at high speeds (Phelps and Morris 2013).

Impact loads are simply those that result from impact with an external body, and can occur during cargo loading, work onboard the ship, or wave slamming resulting in hull girder whipping. While the primary concern after an impact load is the local damage that may be present, they can "significantly increase the number and magnitude of hull girder fatigue loading cycles" (Phelps and Morris 2013, 3).

Operational loads are expected on ships and result from all sorts of different activities which are essential to the function of the ship. Some examples can include the movement of liquids in tanks, helicopters landing and taking off on a deck, or anchor handling on an offshore supply vessel. Note that the effects from such loads are mostly localized, though can result in major high frequency dynamic loading in some cases (Phelps and Morris 2013).

Thermal loads are those that cause strains and stresses in a structure due to change in temperature (Phelps and Morris 2013). As best stated by Hechtman (Hechtman 1956), "It is important to recognize that the thermal strains observed in ships represent the free expansion part of this process and cause no stress but rather are manifested in elongation and bending of the hull" (Hechtman 1956, 6). The point that is being made is that as the temperature of a structure changes at a location, there will be some amount of free expansion in the form of thermal strain. Although, thermal stress can be calculated by considering the temperature distribution and the amount of thermal strain which has been prevented by the rigidity of the surrounding structure. This structural response to the thermal strains is the thermal stress experienced by the structure (Hechtman 1956).

2.5 Existing State of the Art

Hull monitoring is a topic which has gained interest in recent years in both research and commercial applications. The primary goal associated with hull monitoring systems currently in use are to measure global ship motions and elastic structural responses of the hull, use this information to evaluate its condition and then choose an appropriate course of action (Slaughter, et al. 1997). This can include immediate response by the operator of the ship or a long-term plan to continually monitor the state of the hull in terms of structural integrity and fatigue accumulation. “The minimum aim of HSMS (Hull Strength Monitoring System) is to measure global hull girder stresses, to compare these to previously established safe (reference) levels and to provide warnings if these levels are exceeded” (Phelps and Morris 2013, 7).

2.5.1 Strain Gauge-Based Hull Monitoring

Due to technology limitations, load measurements using strain gauges was once challenging; strain gauges, collecting data in analog, were placed at areas where high elastic strain was expected, and the location of the load on the hull was determined during data analysis (Freeman, et al. 2003). A development of the modern strain gauge-based hull monitoring system was created for a research project which set out to collect data toward establishing local ice load criteria for icebreaking ships. The goal was to measure the pressure exerted on a ship from impact with ice while operating in ice infested waters, use this information to determine the loads icebreakers should be expected to encounter, and create design criteria for new ships (St. John, Daley and Blount 1984).

For St. John et al.’s ice trials, a panel was equipped with strain gauges in strategic locations to measure ice pressures as the ship made contact with ice at sea. Specifically, this panel was used to measure compression in the webs of the frames. This way the effect of the ice collision could be captured locally as opposed to measuring the entire ship’s response to the impact. It was found that this method allowed for a high response from one strain gauge at the location of impact on the hull, and significantly less response from surrounding strain gauges. This system was therefore a sensing panel with spatial resolution as high as desired, with regards to strain gauge arrangement. Calibration was achieved using FEA to study the hull beforehand, which produced a matrix of strain readings according to loadings over each strain gauge area. Upon experiencing a load, inverting the matrix would output the location and magnitude of the load. Then, due to the spatial resolution of the strain gauges, the location where the ice made contact was quite clear (St. John, Daley and Blount 1984).

This system performed very well for its purpose during trials, though it had some major underlying assumptions. The method assumed that each load experienced by the panel was a uniform pressure over each area associated with each strain gauge. That means that the pressure determined due to each strain gauge reading was a single value, and it was constant over the square area surrounding it on the panel. Figure 2.3 (St. John, Daley and Blount 1984) shows how this assumption would produce a pressure distribution over the panel for a typical loading scenario.

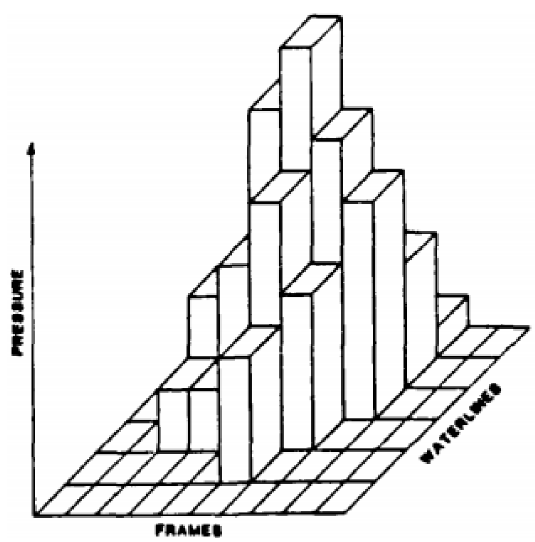

Figure 2.3: Ice pressure distribution on the ship hull derived from strain gauge area (St. John, Daley and Blount 1984).

The other assumption used by this system was that loading resulted in only elastic response by the hull and its internal structure. This meant that during every collision with ice, the hull and its supporting structure would only bend elastically, and then return to its original geometry after the collision ended. This was necessary because the equipment and its arrangement were not capable nor intended to measure permanent deformation; this was a safe assumption as ice loads resulting in major damage was not planned or expected (St. John, Daley and Blount 1984).

Advancements and improvements have been made on this strain gauge-based hull monitoring system in recent years, though their function is the same as described in (St. John, Daley and Blount 1984). In a research effort by the Norwegian Defence Research Establishment, a ship hull structural health monitoring (SHHM) system has been developed and practiced for validation (Torkildsen, et al. 2005). The SHHM system used a network of fiber optic Fiber Bragg Grating (FBG) sensors for strain and temperature. These sensors were placed at the cross section of the ship where the most strain was determined to occur, and had benefits like "their ability to withstand harsh environments, immunity to electromagnetic interference and reducing cabling installation cost when employing multiplexing and multi-fiber cables" (Torkildsen, et al. 2005, 22-2). Loads on the hull are calculated by calibrating a FEM of the ship with the known locations of the sensors throughout the ship. It is noted that fiber optic sensors will produce less noisy data, thus accuracy of the SHHM is improved (Torkildsen, et al. 2005).

The purpose of the SHHM installed on this ship was to determine a variety of variables such as local loads, global loads, sea state, ship motion, and ship state. Local loads were determined from strain gauges on the wet deck of the ship and gave information about the strain at that location induced from wave slamming. Global loads on the hull included moments from hogging and sagging, torsion, horizontal bending moment, vertical shear force, longitudinal normal force, and the spit moment, and these were all determined using the sensors installed at midships. Information regarding the sea state, ship state and ship motion were derived from other equipment such as the Inertial Navigation System, Global Positioning System and Radar Altimeter (Torkildsen, et al. 2005).

Validation of the data collected from the entire SHHM is conducted via scale model testing. It is verified by simulating sea states in a model tank and comparing the results from the scale model to the full-scale data. This method helps show whether the model tank is simulating a sea state correctly, and also allows for validation of the SHHM at full-scale (Torkildsen, et al. 2005).

2.5.2 Unique Approach to Hull Monitoring

A concept hull-monitoring system was developed and tested at sea in another research project due to the prevalence of ice floes off the east cost of Canada and the concern for its interference with crude oil operations and shipping in the area. This novel system employed a new technique of detecting contact and involved mounting a large panel onto the exterior of a ship. The impact panel used a thick sheet of transparent acrylic, a thin sheet of stainless steel, and several strips of very thin, reasonably incompressible tape. The stainless steel was painted black on the side facing the acrylic, and the strips of incompressible tape were spaced 18 mm apart which effectively created a sensing grid of 18 mm x 18 mm. An arrangement of light sources and cameras were installed and directed at the steel sheet through the transparent acrylic. When contact is made with ice, the steel sheet would bend between the strips of tape and, given sufficient pressure, touch the acrylic (Gagnon, Cumming, et al. 2008). Figure 2.4 and Figure 2.5 show a diagram of the novel impact panel.

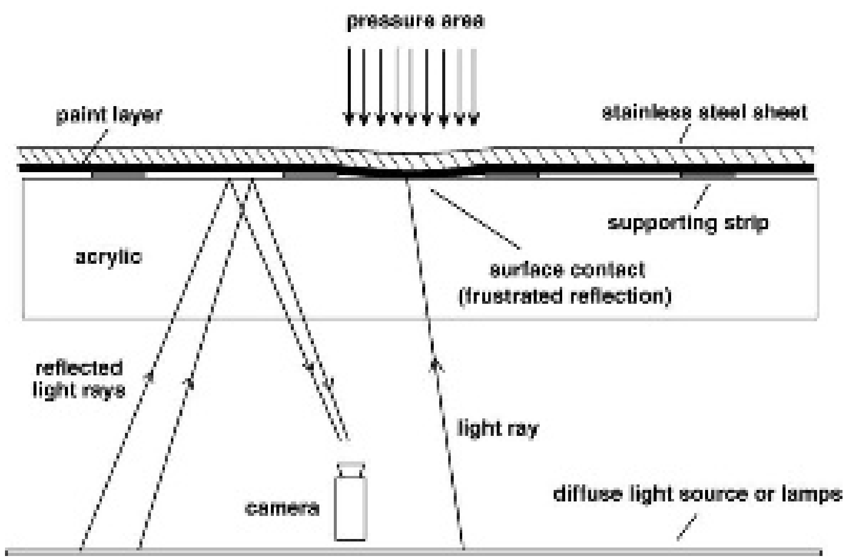

Figure 2.4: External impact panel diagram (Gagnon, Cumming, et al. 2008).

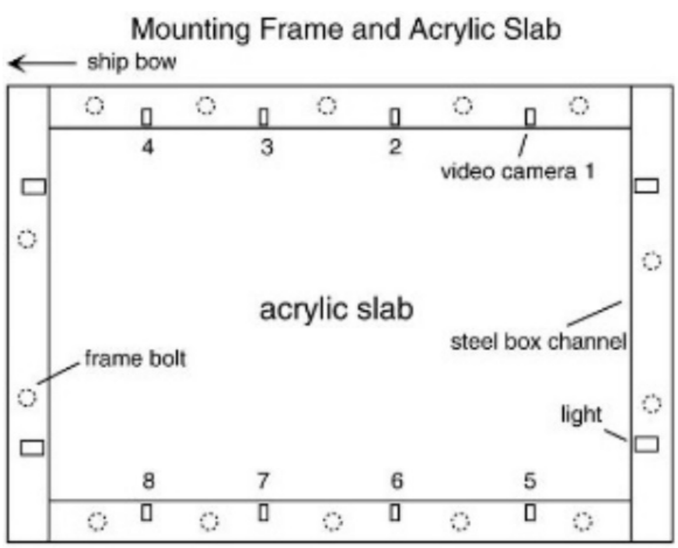

Figure 2.5: External impact panel configuration (R. Gagnon 2008).

With this design, contact with ice can be detected by seeing the steel contact the acrylic through the cameras. The amount of contact it makes with the acrylic is proportional to the amount of pressure applied to the panel. This relationship was determined after the construction process through calibration of applying known loads to the panel (Gagnon, Cumming, et al. 2008).

The panel took advantage of a phenomenon known as frustrated internal reflection. When at rest the light source is reflected off the back of the acrylic, though when pressure is applied to the panel and the tape touches the acrylic the internal reflection is frustrated, making areas where the steel touches the acrylic appear much darker. Therefore, contact areas can be easily identified when viewing the camera recording afterwards (Gagnon, Cumming, et al. 2008).

During this research there was a typical strain gauge arrangement also installed on the vessel, allowing for data comparison during the analysis stage. In general, forces determined via the novel impact panel were consistently lower than those calculated from the strain gauge arrangement. It is important to note that while the hull monitoring methods can be compared, no two identical impacts can be compared directly due to the different locations of the apparatuses (Johnston, Ritch and Gagnon 2008). There were a number of sources of error hypothesized in the analysis, which included:

- "impacts occurred towards the aft end of the Impact Panel, whereas impacts usually were captured more completely by the strain gauged area
- the different bow angles at the two locations

- the larger sensing area of the 5.4 m^2 strain gauged area, compared to the 3.5m^2 Impact Panel, and
- systematic error in the calibration of either instrument" (Johnston, Ritch and Gagnon 2008, 5).

It should also be noted that due to the choice of material and the sensing grid size, the pressure reading could only begin when it exceeded 5 MPa, as determined by calibration (R. Gagnon 2008).

This novel impact panel found great success in determining pressure patterns of ice as it crushed upon impact. During a collision with a bergy bit there was observed through the acrylic some contact areas which were very definitive and short-lived, while other areas did not take a constant shape and held more consistently. This was identified to be the differing crushing mechanisms of harder and softer ice. Hard ice would often be seen as a defined shape, be smaller and have a relatively uniform pressure over its contact area which typically ranged from 8-20 MPa, while soft ice was found to not have a single shape, persist longer and appear before the hard ice appeared. Also, it was noticed that hard ice would not change shape over the impact duration and it would slide along the panel rather than crush, which could account for differences in laboratory test pressures of 30-70 MPa (R. Gagnon 2008). The pressure and contact width relationship as calibrated in the lab is shown in Figure 2.6.

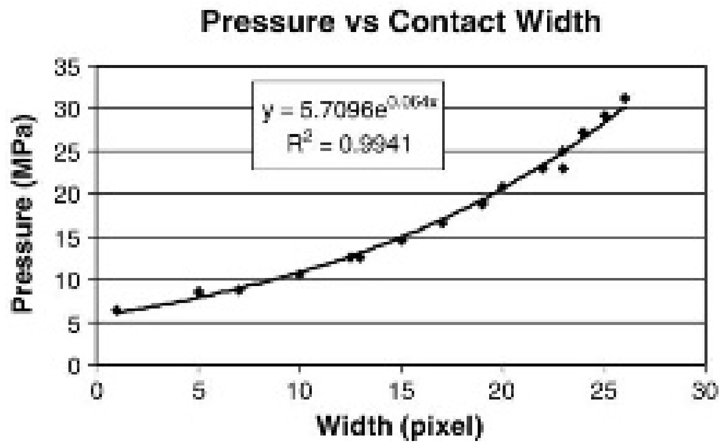

Figure 2.6: Relationship between pressure on the panel and the contact width with ice, developed from calibration before sea trial (R. Gagnon 2008).

2.5.3 Methods of damage detection

An interesting approach was developed in effort of detecting damage beyond the elastic regime in fiber-reinforced plastic (FRP) hulls, and thorough testing shows its applicability to ship hull structural monitoring. This system involves embedding an optical fiber network with laser-Doppler velocimeter (LDV) sensors at strategic locations throughout the FRP hull and on primary structural members. The concept involves calibrating fibers such that their failure strain is known, and using that information to determine if damage has occurred at that location of the hull (Kageyama, et al. 1998). Figure 2.7 shows the schematic of their hull monitoring system on an FRP hull.

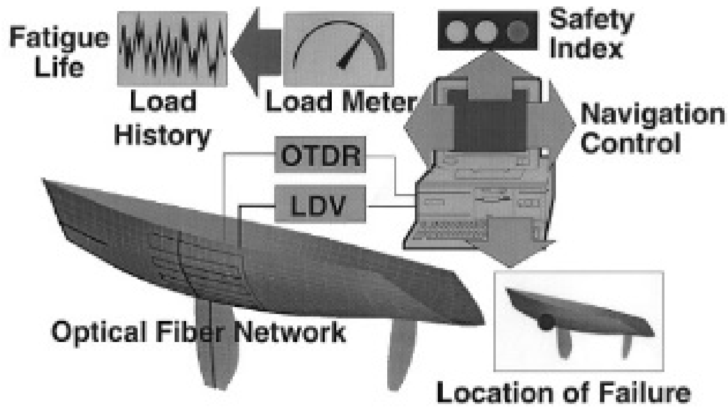

Figure 2.7: Diagram of the fiber-optic network embedded in the fiber-reinforced plastic hull (Kageyama, et al. 1998).

Some benefits of using this approach were that it is applicable in dynamic settings, its sufficiently unaffected by temperature changes, and the length of the system is effectively unlimited as extending the optical fiber system only requires a greater length of fiber. Their experiments found that the system can measure free vibration and deformation when under cyclic bending loads, and it can be monitored with good resolution. A drawback that was observed was that as numerical integration was used for measuring displacement, the frequency of the sensor had to be sufficiently high (greater than 1 Hz) in order for the error to be negligible (Kageyama, et al. 1998).

A different approach was taken by Zubaydi, Haddara and Swamidas as an autocorrelation relationship was developed to determine if damage beyond the elastic response of the structure has occurred. Using FEA, the natural frequencies of a hull side shell model was found by applying an excitation to the structure. A concept called the randomdec technique is used which is based on the fact that a vibration response of a structure has two components, a deterministic component, and a random component. Therefore, by averaging many samples of a response the deterministic component can be found. From here an autocorrelation function is calculated and compared to the new natural frequency of the damaged structure, thus allowing for the detecting of damage (Zubaydi, Haddara, and Swamidas 2000).

Using this method requires an accelerometer to be strategically placed on the structure for measuring its different modes of vibration (Zubaydi, Haddara, and Swamidas 2000). A test was conducted in a laboratory setting to prove the effectiveness of the method, and the experimental setup is seen in Figure 2.8.

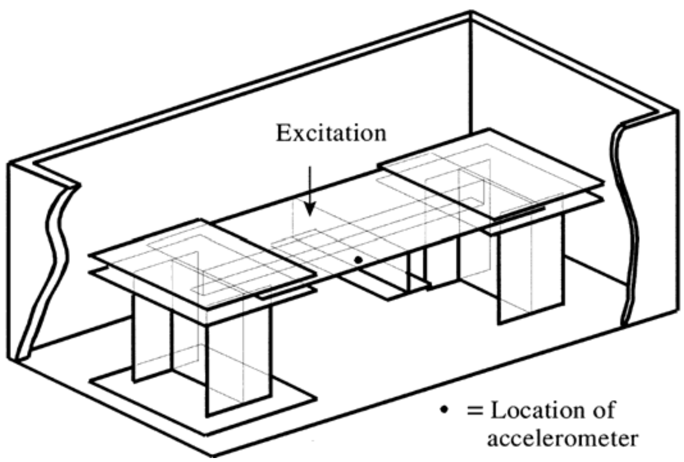

Figure 2.8: Laboratory setup for testing purposes (Zubaydi, Haddara, and Swamidas 2000).

In this experimental study the undamaged structure was given fixed boundary conditions by the use of clamps on its edges, and the excitation was applied to the structure via an exciter which was placed slightly above the center of the plate. The excitation was a known quantity as a load cell was attached to the connecting rod which held the exciter for the experiment. Damage was given to the structure in the form of cracks which were made using a hacksaw, as this tool would make it possible to achieve cracks of widths down to 0.001 inches. Crack lengths varied from 0.4 to 1.2 inches for the experimental runs (Zubaydi, Haddara, and Swamidas 2000). Results comparing the vibrations from the experiment are shown in Table 2.1.

Table 2.1: Results comparing the vibration signatures from the autocorrelation function to the randomdec (Zubaydi, Haddara, and Swamidas 2000).

Comparison of experimental randomdec signature and autocorrelation function natural frequency for the fourth mode (Hz)[a]

No	Undamaged		Crack length					
			0.4″		0.8″		1.2″	
	RS	ACF	RS	ACF	RS	ACF	RS	ACF
1	412.73	412.72	411.59	411.50	408.66	408.64	404.66	404.88

[a] RS = randomdec signature, ACF = autocorrelation function.

It is seen that the vibration signatures aligned very well, and damage was detected based on their severities for each run. It should be noted that while this method can be used for damage detection, it has only yet been proven for detecting cracks in ship structures, and further work is necessary for the detection of plastic bending. Though this can provide great value for systems used in detecting primary support structure cracks, such as on longitudinals and stiffeners.

2.6 Summary

From reviewing the current state of the art technology in hull monitoring systems for ship structures, it is clear that there remains an unexplored area for possible impact scenarios. This area is for major impacts that cause significant plastic damage to the hull structure. Having a system that could monitor, measure, and report the severity of resulting damage from a large impact would have several benefits. Some of which include being able to know the profile of the damage done to the ship, the force that was experienced from the impact, and if repairs are necessary or not. Such a system would provide information to the ship operators that cannot currently be obtained from the studied, existing technology.

Chapter 3 Proposed System Overview

To create an approach to a system capable of measuring force into plastic response regimes, the problem must be investigated and considered in a simpler form. Consider a structure that is a simple plate, with no supporting members, as shown in Figure 3.1. This "plate" will be considered a section of hull structure for research purposes.

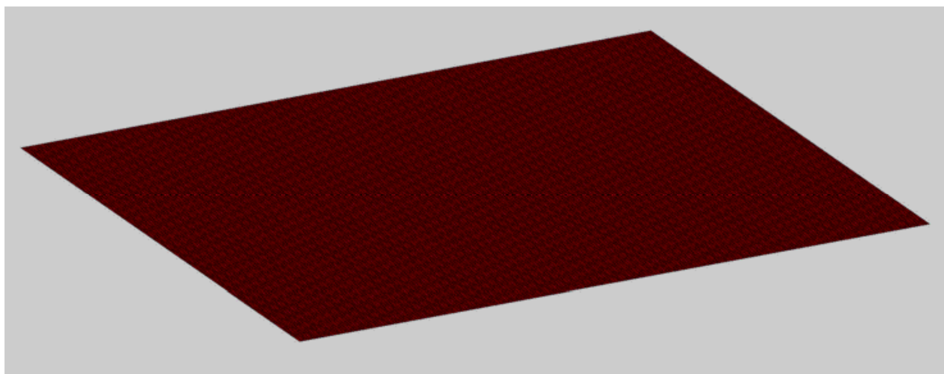

Figure 3.1: Simple plate, representing section of ship hull.

Consider that this plate was to experience an impact at its center. To examine that event, a simplification could be made. It is acknowledged that an event such as an impact with a hull structure would yield a highly non-linear response by the hull, and the stiffness is calibrated in such a way that it reflects the true, non-linear behavior of the plate.

Using the equation of motion, F represents the impact force, m represents the mass and inertial forces of the plate, k represents the stiffness of plate, and c represents the amping, or dissipation of energy in the system. The advantage to simplifying the problem down to this model is that it allows for the equation of motion to be applied, and if calibrated correctly the force at the point of contact on the plate can be determined.

The reason this can work is because this system can exhibit harmonic motion given an external force is applied. Newton's Second Law of motion when incorporated into a body experiencing harmonic motion gives a solution to the system (Moro 2016). Practically, this method would function using acceleration as the only input, after calibration has been conducted. In short, the system would be as follows:

1. Use accelerometers mounted on the inside of the hull
2. Measure acceleration during an impact causing plastic damage
3. Numerically integrate acceleration to obtain displacement
4. Using FEA of the structure for calibration, solve equation of motion to find force

The accelerometer placed inside the hull would measure acceleration during the impact. From here, the displacement at that location can be calculated using numerical integration. A relationship for both the stiffness and mass of the plate can be formed using finite element modelling, and calibration techniques described in Chapter 4.2 Procedure for Creating Model.

Chapter 4 Methodology

4.1 Proposition

The proposed concept for hull monitoring in the plastic regime is to use accelerometers, as well as a FEM of the ship, to develop a numerical model that can use acceleration data from impacts to accurately determine the force and deformation. For the purpose of this thesis, the system of calibrated Finite Element Models (FEM), mathematical functions, and calculations which form the complete proposed system will be referred to as the "Model" for simplicity.

The concept of the Model is to treat the structure as a simple case where the stiffness is modelled from a regression equation retrieved from calibration, the mass of the structure is modelled in a similar way, and the force is the pressure on the structure from a collision with ice or another object. As an accelerometer is the principle device being used in this system, acceleration is being measured as it is experienced from that singular point. From the perspective of the accelerometer, at any instant during the impact the stiffness of the structure can be expressed as a single value, so too can the applied force. At this stage in research a single accelerometer is used, though as discussed in Chapter 6.1 Recommendations for Future Research and Improvements, future research on this proposed system will likely involve a series of accelerometers. In that case, this simplification will still be the perspective from each accelerometer in the system.

It is important to note that the stiffness of the structure is expressed as k. This is an appropriate expression of combined stiffness from hull and supporting members, because from the perspective of the accelerometer it is irrelevant what kind of support is in place; any form of reinforcement and stiffening can be used due to prior calibrations performed with FEA, which will be discussed later.

At this stage, though the Model is complete with a proof of concept (given in Chapter 5.1 Computer-based Validation), it is developed to work only when the accelerometer is placed directly on the opposite side of the structure to the point of impact. Expanding on this limitation is possible and is discussed later in Chapter 6.1 Recommendations for Future Research and Improvements, though the basis of the current concept is for a single point measurement at the location of impact. Technical details will be discussed in the following section.

4.2 Procedure for Creating Model

4.2.1 Numerical Integration to obtain Displacement

The proposed method requires an accelerometer to be placed on the side of the grillage opposite of impact (inside the hull), and that the acceleration be recorded over the duration of an impact. This will be the only input into the completed, calibrated Model. It is understood that as the sole input of data for this Model comes from an accelerometer, the issue of accelerometer drift and time constant should be considered and accounted for where possible (Kistler 2015). As noted by the Kistler information package, “Drift and time constant simultaneously affect a charge amplifier's output. One or the other will be dominant. Either the charge amplifier output will drift towards saturation (power supply) at the drift rate or it will decay towards zero at the time constant rate" (Kistler 2015). At this stage in research, no laboratory experiments have been conducted to test the Model, thus it is unknown whether these issues could impact the results provided from the accelerometer. Although, if experiments are to be conducted the correction methods discussed here should be considered.

To help explain the process of creating the Model, an example will be followed from beginning to end. The example is a case where the structure of interest is a simple, flat, steel plate, measuring 2.05 m x 1.35 m x 8.0 mm. These dimensions were selected as they are the measurements required for the experimental setup discussed in Chapter 5.2.2 Experiment Plan. In this example, there will be a collision with a rigid object at its center. Therefore, the location at which the acceleration will be measured from is the center of the plate.

The first result obtained is the displacement of the location at which the accelerometer resides; the displacement of the center of the plate. The displacement will be essential in completing the equation of motion relationship for the structure. To find the displacement over the time of impact numerical integration is used. Specifically, the Trapezoid method is used to integrate the acceleration at each instant and obtain a corresponding displacement. To prove its effectiveness, FEA can be used to simulate a collision between a rigid body and the plate, and record both the acceleration and displacement of a single node at the center of the impact region. Then, numerical integration can be done using the acceleration, and the result can be compared to the displacement data recorded from the FEA results. This process was completed and the results are shown in Figure 4.1.

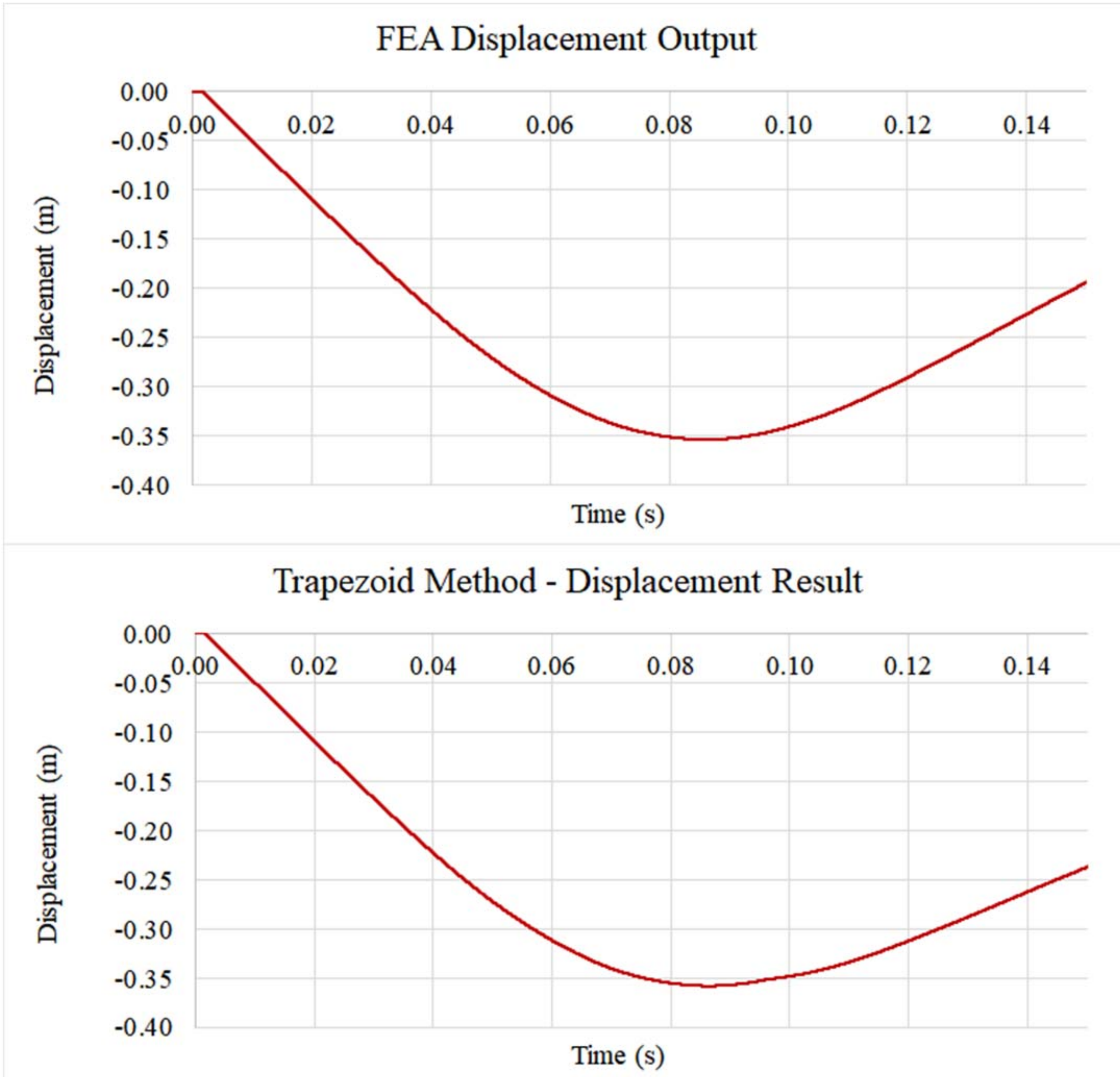

Figure 4.1: Comparison of the displacement results from the FEA output and the Trapezoidal method, numerical integration technique.

As seen, both plots are nearly identical, meaning this method of numerically integrating acceleration to obtain displacement over the duration of impact has proven effective and accurate. An important item to note is the accuracy of the numerical integration and its dependency on the recording frequency of the accelerometer. The example shown in Figure 4.1 uses a sampling frequency of 100 kHz to record acceleration data, meaning the acceleration is recorded 100,000 times every second. At this sampling frequency the time between data points is very low which in turn permits for a very low and insignificant error. Therefore, it is essential for the accuracy of the Model that the sampling frequency be sufficiently high.

4.2.2 A note on Damping

A collision with a ship by any external body is a transient event, as actual contact can happen over a time of 0.039 to 0.083 seconds, as observed by Gagnon, et al. (Gagnon, et al. 2020). A collision of this type would mean the mass would compress the spring very quickly and then settle at a new, displaced distance (i.e. Plastic deformation). A visualization of how this motion appears is given by the simplest case in Figure 4.2.

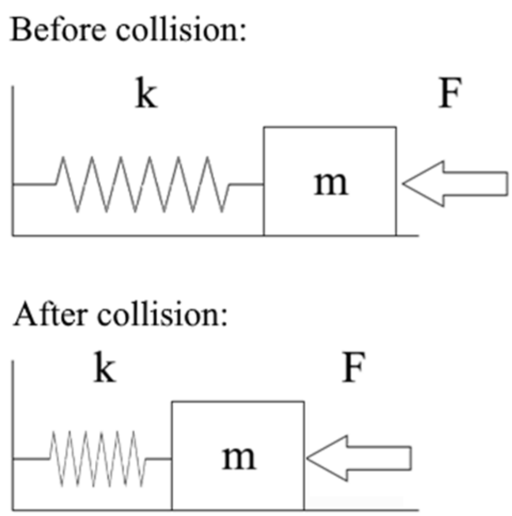

Figure 4.2: Simplified model of a collision between plate, *m*, and external body, *F*.

Figure 4.3 shows in an amplitude of displacement over time plot for a simple damped oscillation. The red-dashed line indicates the motion experienced by the center of the plate in this ongoing simple plate collision example.

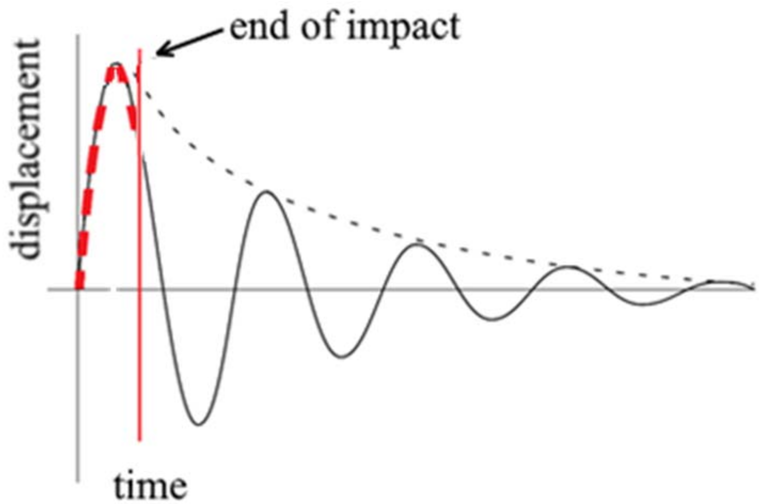

Figure 4.3: Amplitude of displacement of a simple damped oscillation example. Red line indicates the motion of the center of impact in the case of the simple plate collision example.

In the equation of motion, equation [2], the force is found by the summation of the inertial (ma), dissipation (cv) and stiffness (kx) forces. In this application, it is safe to ignore the damping portion of the equation of motion as its contribution to the overall force is negligible. If the impact scenario involved the colliding object sticking to the structure and causing periodic motion, then damping would be a significant contributor. Although, as the event happens quickly and in one direction, there is no need to calibrate a function to describe the damping active in the impact event. With this assumption, the equation of motion is now simpler and effectively becomes independent of damping, shown in equation [3].

$$F = ma + kx \qquad [3]$$

4.2.3 A Relationship for Stiffness, *k*

Having obtained the displacement at each instant over the duration of impact, it is now possible to find a stiffness function. This function will describe the relationship between the force required to deform the structure a given displacement. For simplicity, the stiffness function will be found with respect to the center of the structure, meaning that the applied force and recorded displacement will be measured at this mutual location. To acquire the stiffness function, the equation of motion must first be considered and used to determine how to best create a FEM to allow for such calculation. The equation of motion, equation [2], accounts for displacement, *x*, speed, *v*, and acceleration, *a*. Though if the stiffness, *k*, is desired then we can take advantage of implicit static FEA as it is independent of time and acceleration will not then be possible. That is, if using an implicit static solver to simulate a collision with the plate, the only computation of force which will occur will be that which results from the time-independent equation of motion, or simply Hooke's Law, equation [1].

Using this technique, it is possible to determine a function which describes the force resulting purely from the stiffness of the plate. This function will be determined by recording displacement and force over the duration of the impact in FEA, and plotting a curve from the rearranged version of equation [1], in equation [4].

$$k = \frac{F}{x} \qquad [4]$$

The FEM for this step is shown in Figure 4.4. An object made of rigid material, referred to as the "indenter," is placed at the center of the plate and is assigned to translate 25 cm over the course of the simulation. In this FEM, the boundaries of the plate are fixed, meaning that all nodes along the edges of the plate are not permitted to translate or rotate in any direction.

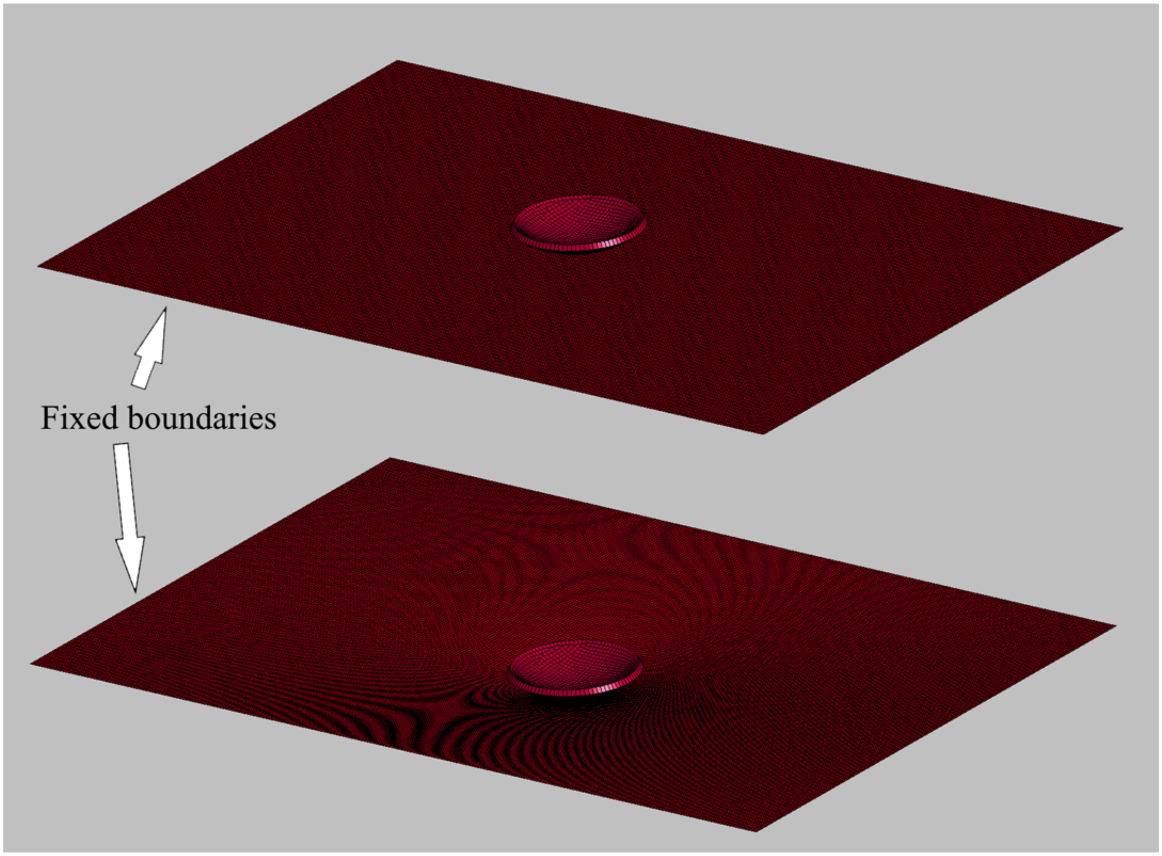

Figure 4.4: Starting and ending conditions of the discussed simulation.

Note that the distance the center of the plate displaces in this step is vitally important to the remainder of the Model. When creating this FEM it is important to understand the severity of expected damage in the real world. If developing a Model for a structure which is expected to experience actual impacts causing a maximum of ~25 cm of displacement, it is important to ensure the implicit FEM is made to displace at this location at least 25 cm as well. Note, it is acceptable to calibrate beyond this limit, such that an impact with greater than 25 cm (say, 30 or 40 cm) is simulated, though to simulate a less severe impact will result in an uncalibrated stiffness function which will not be equipped for displacement inputs above what was simulated. Figure 4.5 shows that the maximum displacement in the implicit static FEM was ~25 cm, which means that if this example were to be tested in the real world, analyzing an impact that had a deformation greater than 25 cm cannot be reliable due to the improper calibration.

In the simulation, the total force experienced by the fixed boundaries of the plate is recorded. The stiffness is then calculated, at each instant, using equation [4]. By then plotting the calculated stiffness by the displacement, the function fitted to the data will output the stiffness at any displacement up to the calibrated limit. In Figure 4.5, the x-axis is displacement while the y-axis is the calculated stiffness. Having a stiffness function with respect to the displacement will make the function transferrable to further use, as it will not depend on time or acceleration.

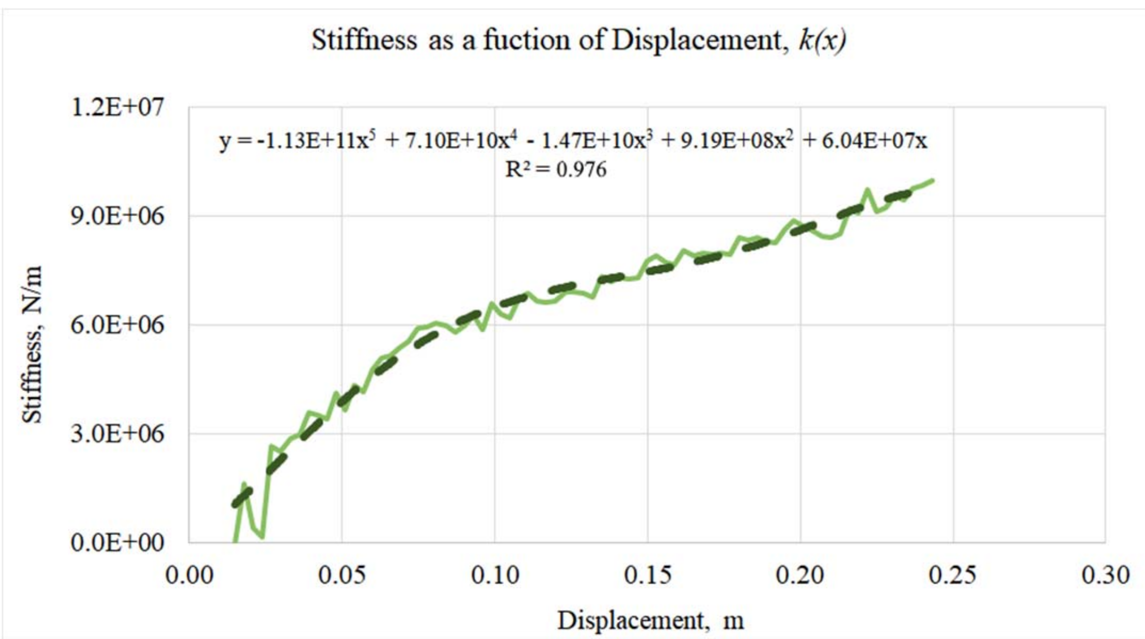

Figure 4.5: Stiffness function in the form of *k(x)* to be used to determine the stiffness of the plate when the displacement caused by impact is known.

The relationship determined to describe the stiffness of the plate for this example is shown in equation [5]. The more accurately the trend-line describes the data the more accurate it will be to measure stiffness in practice. For this example, the trend-line provided the function with a fit of $R^2 = 0.98$.

$$
\begin{aligned}
k(x) = &-112\,978\,168\,800\,x^5 + 70\,967\,975\,609\,x^4 - 14\,700\,709\,215\,x^3 \\
&+ 918\,664\,638\,x^2 + 60\,406\,773\,x
\end{aligned}
\qquad [5]
$$

The results from the stiffness relationship calibration run are provided in Appendix A FEA results and calculated stiffness from stiffness relationship calibration. Note that as per this proof of concept, the measurement of acceleration is taken at the center of the plate. It is noted that strain-rate effects are not accounted for at this stage in research, and thoughts have been given to this topic in Chapter 6 Conclusions and Recommendations.

4.2.4 A Relationship for Mass, *m*

At this stage, the only remaining variable in the equation of motion for the structure is the mass, *m*. This does not mean that the actual mass of the structure can be used as a coefficient, because the equation of motion will be used to solve for the instantaneous force at many intervals during an impact, and the portion of the structure which is responding to a load at a given instant during impact will determine how much mass is contributing to the response force. The idea is that only a portion of the structures mass is responding to a load each instant over time. In this method it is referred to as “effective mass,” and describes the portion of mass of the structure that is reacting to the contact with the external body. The reason for thinking of mass in this way is because it will help calculate the inertial force that is experienced by the structure.

The requirement for this remaining portion of the equation of motion is to determine a function that outputs values of mass of the structure at each time step of the impact. Before, when finding the stiffness function, time could be ignored which allowed for a simple governing equation to calculate the force. Though, when finding an effective mass function, it must be considered that the force as a result of inertia is directly related to the acceleration. As acceleration can only be achieved over time, an implicit static finite element simulation will not be appropriate. An explicit FEA is now used as it provides computationally efficient numerical solutions to impact problems, and therefore, the effects of inertia can be captured.

An important remark to make is that though the stiffness function could be made with respect to only displacement (*k(x)*), the mass function must be determined with respect to both acceleration and displacement (*m(a,x)*). Stiffness can be found this way because it is independent of motion over time; a given displacement will result in a reacting force in an elastic structure (Clough and Penzien 1993). This is not the case for effective mass, because as something contacts a structure, a range of accelerations and decelerations will be experienced by the location of impact, and its deformation can be either very little or large. In the domain of all possible deformation scenarios at a single location for a structure, it is possible for an arbitrary displacement to exist at several different accelerations caused by different impacts.

Consider, for example, that a structure is impacted at its center by an external body at a collision speed of 10 m/s and there it plastically deformed 10 cm. It can be said that the location which is now 10 cm displaced relative to its original location, must have first displaced 1 cm, then 2 cm, and so on, until it settled in its new position at 10 cm. Now consider the same structure was instead impacted by the same external body but this time at only 1 m/s, which caused it to plastically deform by 2 cm. Comparing the two scenarios, it is clear that at some stage the displaced location was at 1 cm. Though, in the first scenario the acceleration experienced must have been much higher than in the second scenario. It is due to possibilities like these that a relationship for effective mass must be created with respect to both displacement and acceleration, as it will permit for accurate effective mass calculations for a range of impact scenarios. It is safe to ignore speed as an input for the effective mass function because damping is also being ignored; since it is assumed that damping has a negligible effect then the total force will not vary with speed. Although, it is important to understand that in doing this the effects of strain-rate are ignored as they are outside the scope of this research at this stage and are not considered. Considerations to strain-rate effects on this work are discussed in Chapter 6 Conclusions and Recommendations.

Similar to how the stiffness function was found, the effective mass function must use a surface regression to form a relationship as mass will be a function of two variables – acceleration and displacement. Using explicit FEM, a range of accelerations is chosen based on the prior investigation of a full FEA of the impact; by analyzing an FEA of the worst-case impact beforehand, the maximum acceleration that will be experienced can be found. Using this value, we can now conduct multiple similar FEAs in order to collect displacement and force data for a wide range of impacts.

To begin, FEA is used to model the same rigid indenter that is assigned a constant, unchanging acceleration from start to finish of the event. That is, the indenter will accelerate at whichever value is assigned to it no matter what opposes its motion. This is advantageous as each run with constant acceleration will capture the displacement response at a; by conducting several constant acceleration impacts with a ranging from the maximum expected acceleration, down to a near-zero a, a large range of a-x combinations can be captured and later used to determine an effective mass function.

For each of these simulations, the event will begin in the same position as did the FEM for the stiffness relationship, with the indenter resting at, and facing the plate. Upon accelerating into the plate and causing a relative displacement of a maximum of ~25 cm between the center of the plate and its edge, the event ends. Most accelerations did not result in this high of a displacement, as it is very difficult to create a 25 cm dent into a steel plate. Nonetheless, for runs with assigned accelerations insufficient to cause such damage, the event ends the moment the plate stops exhibiting plastic flow behavior. That is, when the plate is no longer increasing in plastic strain around the area of impact.

For the continued example of the simple plate, several constant acceleration simulations were conducted which ranged from 8000 m/s^2 to 500 m/s^2, at intervals of 500 m/s^2. Using the collected displacement, acceleration, and contact force data from each FEA, the stiffness was calculated at each time step using the function found earlier, and then the effective mass was found at each time step by rearranging the revised equation of motion, equation [3], for mass, m, as shown in equation [6].

$$m = \frac{F - kx}{a} \qquad [6]$$

Next, a 3D surface can be made using data collected for the *a*, *x* and *m* variables from all constant acceleration runs. The surface is fit to the data and a regression function can be generated as shown in Figure 4.6. The regression equation has the form of effective mass as a function of acceleration and displacement, *m(a,x)*.

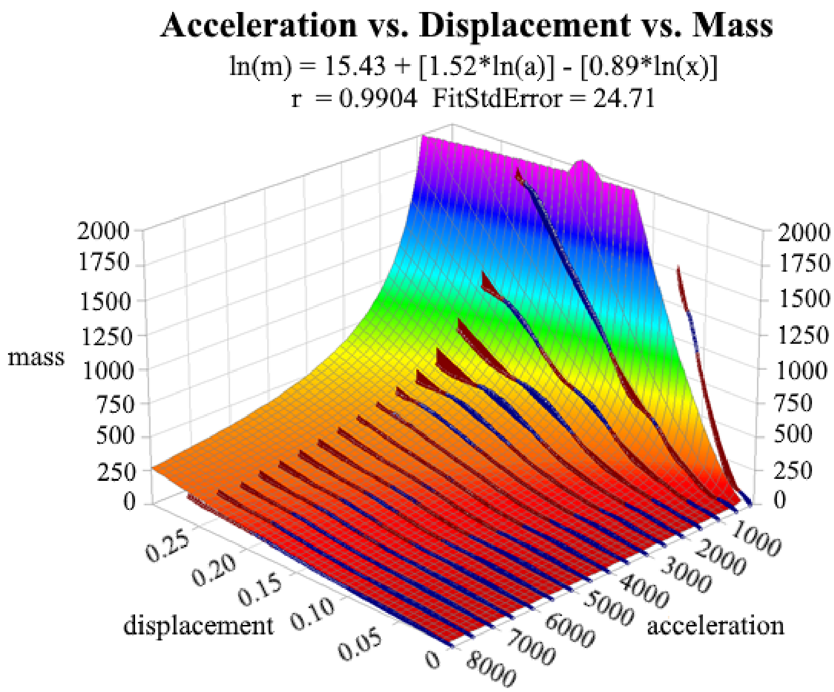

Figure 4.6: Surface regression fitted to resulting effective mass data from calibration runs.

As produced by the fitted regression surface, the resulting equation for the mass relationship is given in equation [7]. The fitness of the regression to the data is R^2 = 0.9904.

$$m(a,x) = e^{15.43+[1.52*\ln(a)]-[0.89*\ln(x)]} \qquad [7]$$

It is important to note that this method of finding a relationship for effective mass should, in theory, work perfectly in the event that the structure in question has supporting members, like stiffeners, or if the structure has obscure geometry. This is due to the fact that from the perspective of the mathematical function created, there is only attention given to the displacement and acceleration responses of the structure. As the acceleration is measured from a singular point, then, no matter how the geometry takes form, the mass function determined should be accurate.

Due to the length of the table required to print the results, results from only the first effective mass relationship calibration run (500 m/s^2 assigned to the indenter) are provided in Appendix B FEA results and calculated mass from mass relationship calibration. Note that as per this proof of concept, the measurement of acceleration is taken at the center of the plate.

As explained, the equation of motion adjusted for the proposed model is in equation [8].

$$f(t) = k(x)\,x(t) + m(a,x)\,a(t) \qquad [8]$$

To summarize, force as a function of time is equal to stiffness as a function of displacement, multiplied by displacement, and mass as a function of acceleration and displacement multiplied by acceleration.

4.2.5 Finite Element Modelling for Proposed Model Development

4.2.5.1 Finite Element Model for Stiffness Relationship

As per the example from the previous section, the FEM for this step consists of two parts; one is the section of structure, the plate, and the other is the rigid indenter. The plate is meshed entirely of shell elements, is 2.05 m x 1.35 m, and assigned a parameterized thickness of 8.0 mm. Rationale for using shell elements in this part was that its measurements were much greater in two dimensions than the third, and there were not going to be any externally applied in-plane loads involved in either the calibration or validation stages. Boundary conditions assigned to the structure are fixed on all edges such that the entire part cannot translate in or rotate about any axis. The material model created for the structure was of steel, had a stress-strain relationship as given in Figure 4.7, and had the following parameters:

- Density, $\rho = 7850\ kg/m^3$
- Young's modulus, $E = 209$ GPa
- Poisson's ratio, $\nu = 0.30$
- Failure strain, $\varepsilon_f = 0.37$
- Yield Strength, $\sigma_y = 328$ MPa

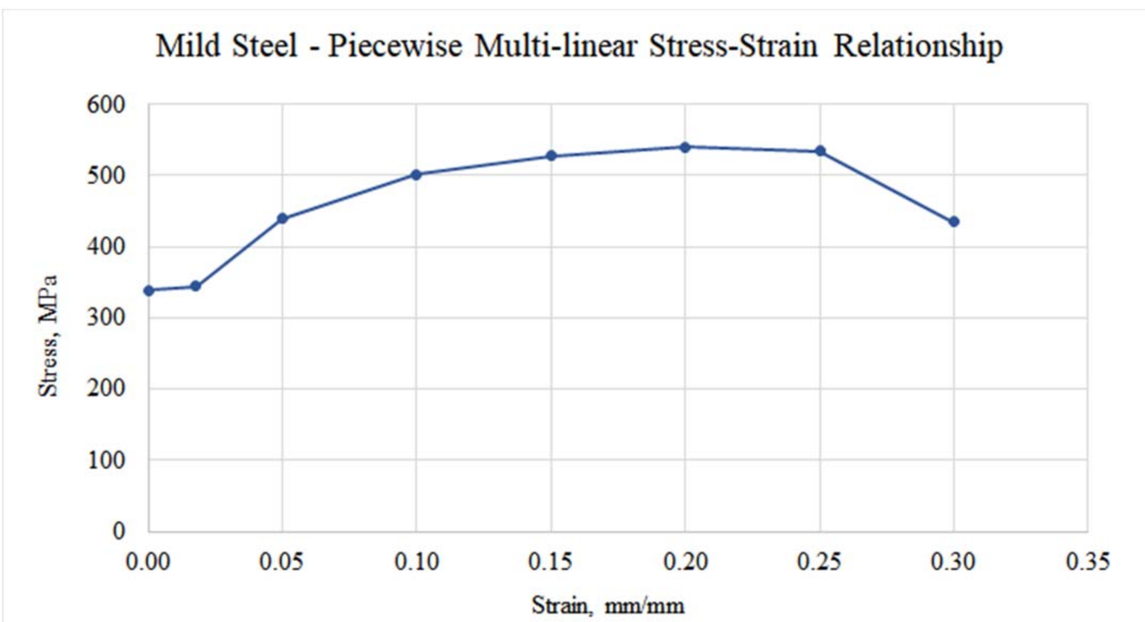

Figure 4.7: Stress-strain curve for the material of the steel plate. Shown is the plastic regime behavior of the curve; post-elastic behavior.

Figure 4.7 gives the stress-strain relationship for plastic behavior of the steel material model used in the FEM. The elastic portion of the stress-strain relationship follows the noted Young's Modulus, E = 209 GPA. A mesh convergence analysis was conducted in order to determine which element size would be appropriate to capture the realistic response of the simple plate, and to also maximize computational efficiency as best as possible. In total, six mesh sizes were used to generate the same FEM of the simple plate. Mesh sizes ranged from 200 mm down to 8 mm as lower than this value could have caused issues, due to the fact that the parameterized thickness assigned to the shell elements was also 8 mm. The mesh convergence analysis consisted of applying an increasing force to the entire plate with its edges fixed, and was conducted in a manner which compared the maximum displaced node of each mesh over the time of the simulation. This method of comparing performance over time was used rather than comparing a single value of displacement for each mesh, as dynamic effects due to the applied force can cause a singular point to be misrepresentative. If one of these misrepresentative points were selected during the mesh convergence analysis, correct comparisons between mesh sizes cannot be made. It was determined that the mesh was safely converged at an element size of 8 mm. The mesh convergence analysis graph of results is shown in Figure 4.8. The results show the maximal displaced node of each of the six runs over the duration of their simulations. It is seen that the largest mesh sizes under predict the displacement, though the mesh size safely converges at 8 mm.

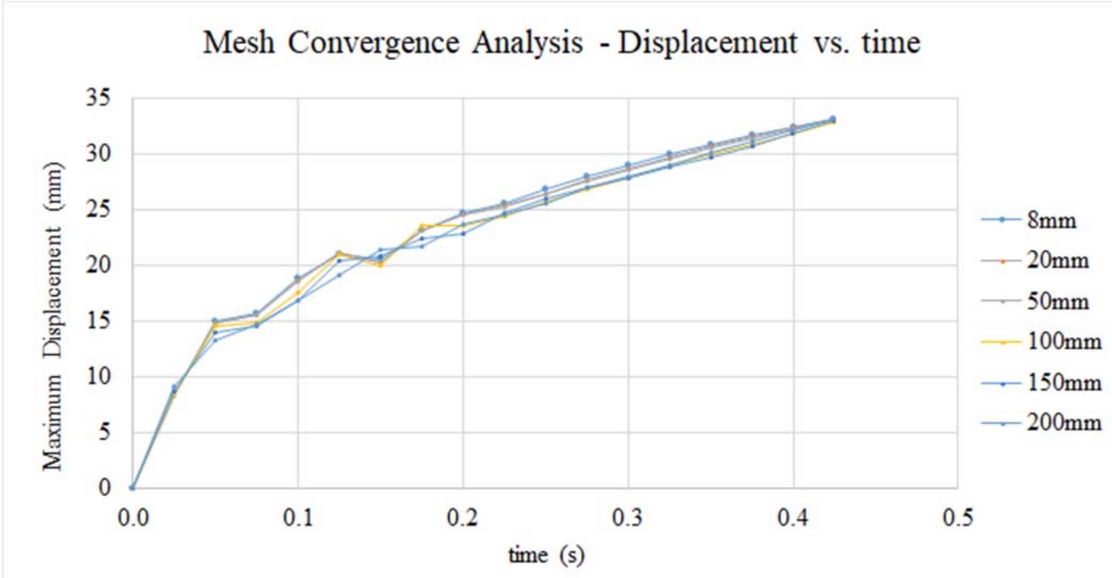

Figure 4.8: Mesh Convergence Analysis results.

The indenter is made of solid elements and has a geometry of a "slice" of a hollow sphere with the convex surface facing the center of the structure. It measures 30 cm in diameter, 5 cm in height, and has a thickness of 15 mm. The indenter is created by generating a sphere of shell elements and deleting about five-sixths of the sphere. Then, solid elements are generated from the concave face of the semi-sphere at a distance of 15 mm. By then deleting the shell elements the remaining mesh is entirely of solid elements. Solid elements were used here because they perform well in contact with deformable shell elements. The material model assigned to this part is rigid material as the response of the indenter is not of interest. Using an implicit static FEA solver, the event modelled is the rigid indenter moving into the plate a distance of 25cm. The plate deforms but does not translate as a whole. The displacement increases linearly until the simulation terminates as shown in Figure 4.9. A visualisation of start and end states of the simulation are given in Figure 4.10.

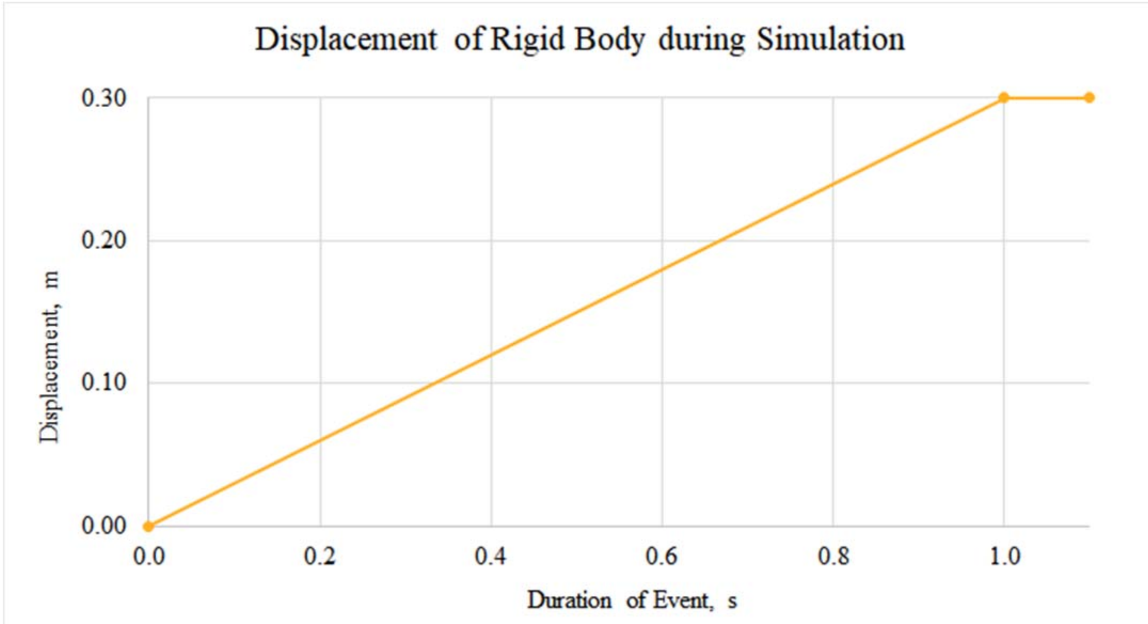

Figure 4.9: Rate of displacement increase over duration of implicit FEM.

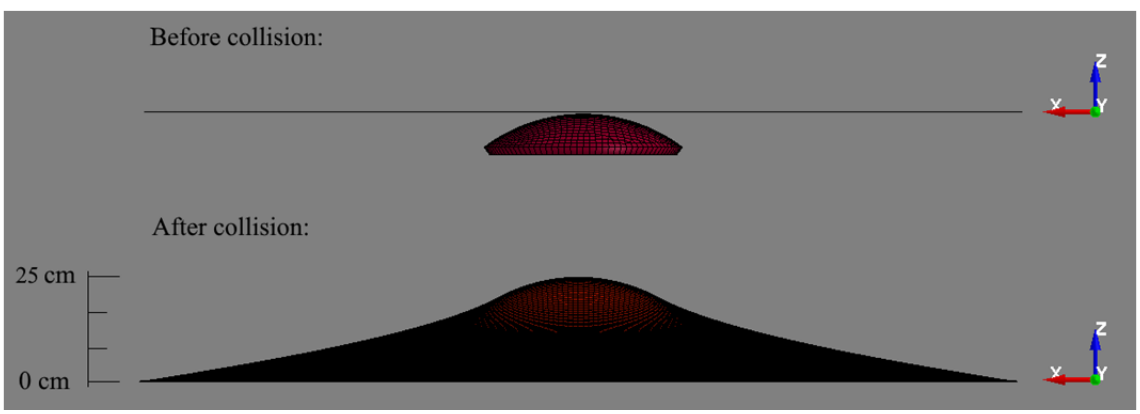

Figure 4.10: View of the same simulation in the X-Z plane. Shown is the final condition of the plate, after being impacted and damaged by a maximum displacement of 25 cm.

The output of this FEA is the total resultant force experienced at the boundaries. This means as the boundaries of this structure are fixed along all edges, the entirety of the force resisting the deformation of the structure is carried by the fixed edges. By recording the total force reaction of the boundaries and knowing the displacement curve assigned to the center of the structure, its stiffness can be easily calculated using Hooke's Law, equation [1]. The number of sub-steps used in this FEM should be high enough to allow for a sufficiently detailed stiffness curve as the regression equation will be determined from its trend-line. For this example, 77 sub-steps were used.

4.2.5.2 Finite Element Model for Mass Relationship

The FEM for determining the effective mass function is tedious as it will have to run several times for an accurate regression to be formed. The two parts included in this model are the section of the structure of interest and the same rigid indenter. The modelled event involves the indenter being at rest facing the center of the structure when the simulation begins and accelerating at an assigned value towards the structure until the termination time is reached. The goal is to measure the reaction of the structure before it begins to exhibit rigid body motion, as this will help determine how the plate responds to impacts for a range of accelerations and displacement combinations.

The structure in this FEM has the same dimension, element, material, and mesh parameters as before, though the boundary conditions are quite different. The boundary conditions for this stage are such that its edges are fixed in translation for directions in the plane of the plate, but not for the direction normal to its surface. That means that for the continued example, translation is restricted along two axes, and is free in the axis of the direction of impact. Rotations about all axes are also restricted. A card named CONSTRAINED_NODAL_RIGID_BODY_SPC is used; a constrained nodal rigid body boundary condition is assigned to the edges of the structure as it would "fix" the edge nodes relative to each other. This means that all nodes along the edge of the plate are restricted from moving independently, rather the distance between each edge node and the node adjacent to it along the edge will remain unchanged the entire time. The reasoning for this choice of boundary conditions is to mimic those in the planned laboratory experiment (refer to Chapter 5.2).

The indenter is the same part as discussed in the previous section. The rigid material model is still used as it is necessary to perform the same impact each time the simulation is run. If any material other than rigid were used, then the response of the structure to the indenter would be different with different collision accelerations. Using a rigid material made it easy to ensure the same contact was being simulated each run. Regarding boundary conditions of the indenter, it is restricted from rotations in all axes, and allowed to translate only on the axis of the direction of impact. For the indenter, the BOUNDARY_PRESCRIBED_MOTION_RIGID card in LS-DYNA is used to assign a known acceleration value as it varies each run. This is used because it means the value of acceleration given to every node in the indenter is the acceleration it will have immediately as the simulation begins until the termination time, no matter what object opposes its motion. This is needed in the calibration process because it allows for the acceleration value to be kept constant. After each simulation, the acceleration of the center of the structure will be inferred because it will match the value that was assigned to the indenter. Therefore, it is only necessary to collect the displacement and contact force data from each run. Also, by using this method of keeping one variable constant each run, it is easier to see if the required range for calibrating has been met.

Contact between the two parts is achieved in this FEM by using the LS-DYNA card CONTACT_AUTOMATIC_SURFACE_TO_SURFACE. This contact definition worked well as the mesh sizes of the colliding parts were similar and the collision involved shell elements with solid elements. Each simulation in this stage involved colliding the indenter into the structure at a known rate of acceleration, measuring the displacement of the center node of the structure, and the contact force between the two parts. Contact force is collected to satisfy the equation of motion and solve for the effective mass, m, variable for now. Later this information is used to determine a function, $m(a,x)$, to describe how a measured displacement and acceleration relates to produce effective mass, m.

Chapter 5 Results and Discussions

5.1 Computer-based Validation

At this stage, the Model has been developed and it can be validated. The first validation which should be performed is the computer-based validation by using FEA to simulate a realistic impact that the ship could experience while at sea. Performing this check will ensure that there have been no errors while carrying out the stiffness and effective mass regressions. While this will verify that the work done in developing the model has been performed correctly it will not ensure that this system will operate perfectly in a real-world environment. To prove that the Model works in practice a laboratory experiment should be conducted as it will allow for realistic acceleration measurements and displacement combinations. FEA can be a great approximation of real-world events though it will only be as accurate as the information given to it by the user. If material information or boundary conditions, for example, are not accurate to begin with, then there can be major differences when attempting to validate the Model.

The FEM for validation purposes resembles the FEM described in Chapter 4.2.5.2 Finite Element Model for Mass Relationship, and FEM parameters are exactly the same with the exception of the prescribed motion to the indenter. However, the prescribed acceleration is not used, and instead an initial velocity is assigned to the indenter using the INITIAL_VELOCITY_GENERATION card. This means that the indenter starts at the velocity value given to it and exhibits rigid body motion immediately thereafter. This is used here because in the experimental setup, discussed in Chapter 5.2.2 Experiment Plan, this would be the case; the indenter would contact the structure at a certain speed, the structure would react, then the indenter would decelerate and eventually rebound backward.

For the first validation run, an impact speed of 4.091 m/s was used. The FEA for before, during, and after the impact are given in Appendix C 4.091 m/s simulated impact validation It shows the three stages of the FEA event; before impact when all parts are at rest, during the impact when the indenter collides with the plate and is causing its maximum deformation, and following the impact when the indenter rebounds backward.

When performing validation runs the necessary data to record are the acceleration and displacement of the center of the plate, and the contact force between the two parts. The displacement and contact force are collected and used to check the results from the Model, and the acceleration is collected, to act as if there is an accelerometer, and it is the only information that can be collected. In a real-world event acceleration would be the only data collected from the accelerometer.

To use the model, the acceleration data is entered into a spreadsheet where the method as described in Chapter 4.2 Procedure for Creating Model is executed. To recap, the displacement of the center of the plate is found by numerically integrating the acceleration data at the same location from the beginning of first contact. Also, the stiffness, k, and effective mass, m, are calculated using the determined regression equations. This now satisfies all parts of the equation of motion for the structure and a prediction of the force over the impact can be made and compared to the contact force that was produced from the FEA. Appendix D 4.091 m/s simulated impact validation results shows the Model predicted force from the 4.091 m/s impact run, as well as the acceleration input and calculated displacement, stiffness, and effective mass results.

By plotting the force predicted by the model and comparing it to the contact force produced from the validation run FEA, it can be seen that the Model fairly accurately predicts the force on the structure over the impact, as shown in Figure 5.1.

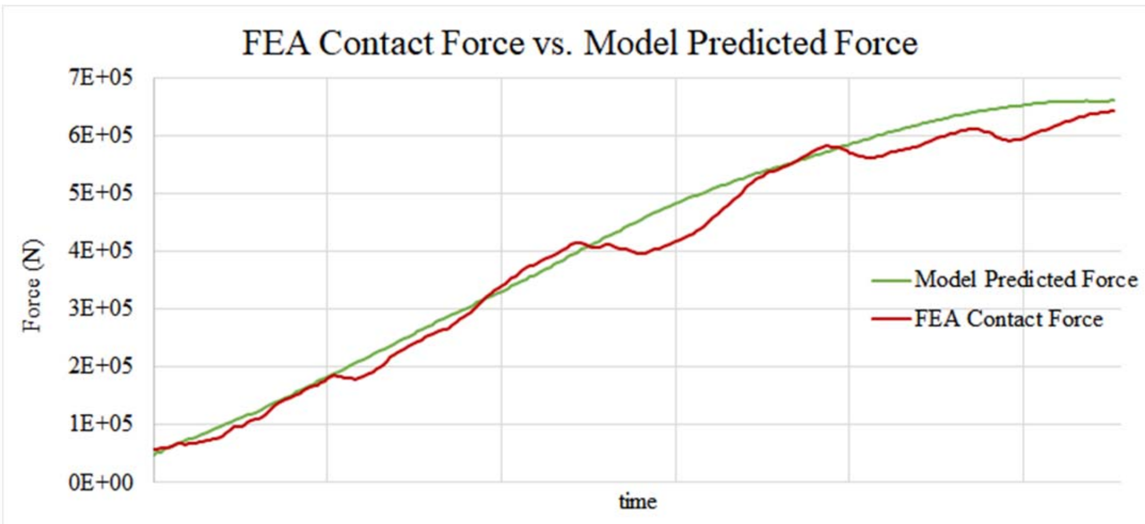

Figure 5.1: Model predicted force compared to actual contact force as provided from FEA.

The plot shown only gives the force comparison for one specific part of the impact. The part that is shown represents the force on the structure at the instant that plastic behavior is being exhibited by the structure, until contact begins to be relieved.

A structure such as the steel plate being used in the ongoing example can demonstrate free vibration or forced vibration in its undamaged state. Free vibration can occur either without applied force but with some given initial conditions and will cause vibration as per the natural frequency of the plate. Forced vibration results from an external excitation force and can cause a harmonic or transient response from the plate, depending on the type of excitation (Pouladkhan, et al. 2011). Once plastic deformation happens in a structure, its mode of vibration will change, and its free vibration mode will be different than its original. As plastic deformation occurs over time and the material is in a plastic flow state, the mode of vibration of the plate is constantly changing and will not settle on one until the deformation stops happening. Therefore, during this short period of time there will not be a dominant vibration pattern and acceleration data should not be as affected by plate vibrations. For this reason, the Model will best perform when acceleration data is read during plastic flow as there will be little other noise.

Figure 5.2 shows the error of the force calculated from the Model from the same 4.091 m/s impact validation run. The error is obtained by finding the difference between the FEA contact force and the Model calculated force.

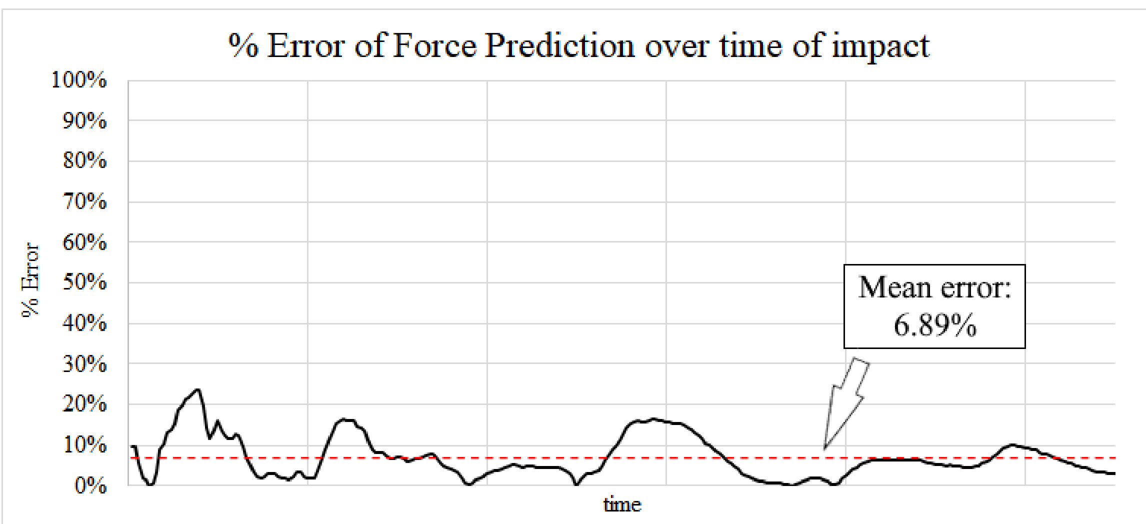

Figure 5.2: Percent error of the Model predicted force over duration of the impact of the validation run.

The red dashed line shows the average error over the impact duration, which for the computer-based validation is 6.89%. To best illustrate where Figure 5.1 and Figure 5.2

are showing results in terms of the impact event, Figure 5.3 shows where significant events align with the plots.

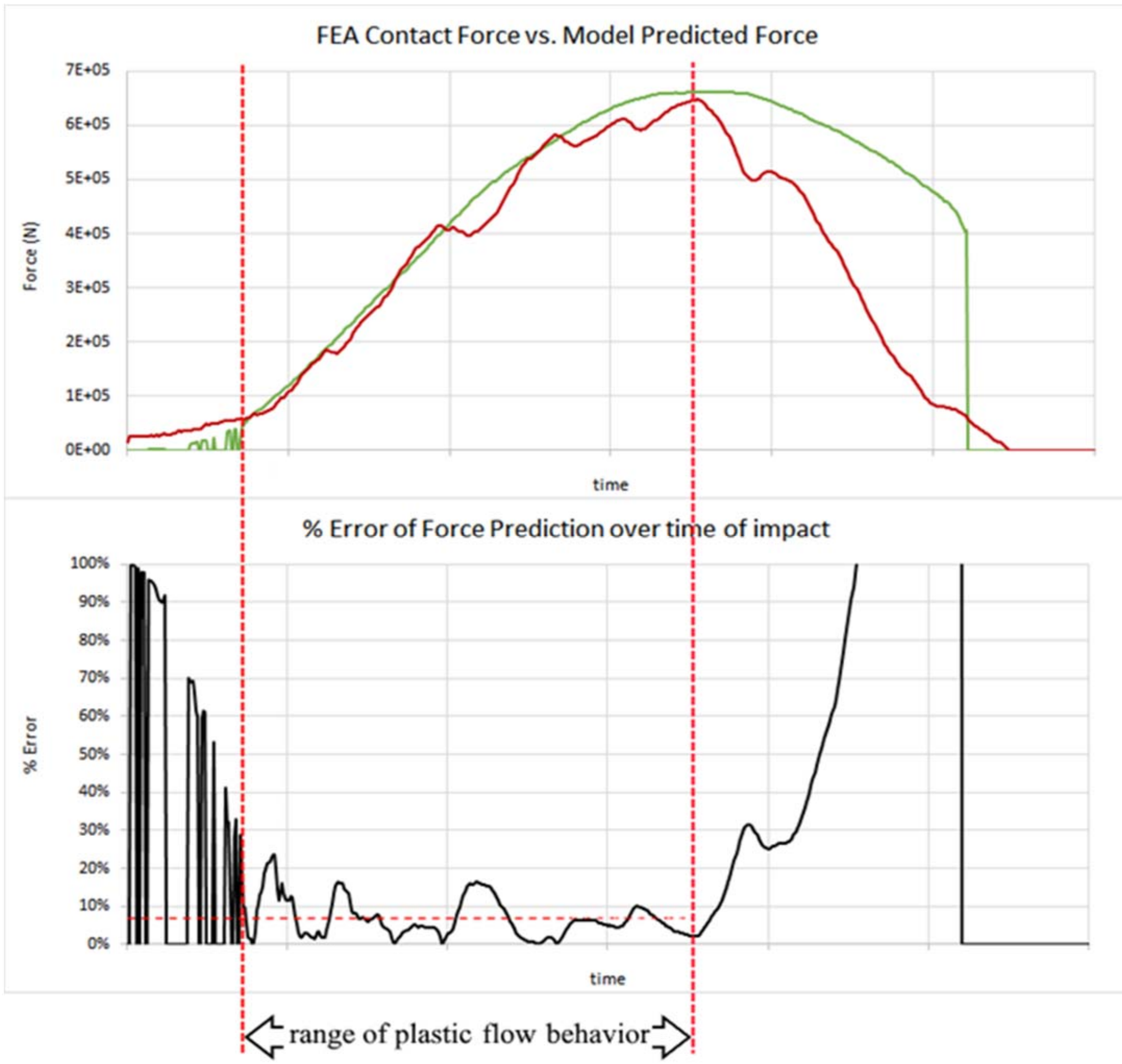

Figure 5.3: Alignment of force comparison and percent error plots over time span; illustrating initiation of plastic response and end of the plastic flow behavior of the plate deformation.

Computer-based validation is useful for verifying that work put into developing regression functions and ensuring all calculations run properly, and it is encouraging to achieve results such that the average error is only 6.89%. However, it is important to understand that nothing has been proven using real-world data at this stage. If an experiment were to be conducted to test the Model using a real impact in a laboratory, some differences should be expected with the inputs which can affect the error. Differences between a computer-based validation and an outlined procedure to a laboratory-based validation strategy is discussed in Chapter 5.2 Laboratory Validation Strategy.

5.2 Laboratory Validation Strategy

Due to the restrictions put in place as a result of COVID-19, during the time this thesis was written experiments planned by the author became impossible to conduct during the scope of this thesis work. For this reason, a laboratory experiment plan is outlined as it was planned to go ahead after the Model was developed.

A laboratory-based validation strategy has the potential to be a proof of concept for the Model in its current state, given the results compare reasonably with the Model results. An initial check in having realistic acceleration data can verify that finite element trial experiments were accurate enough such that the Model is calibrated for the appropriate range. Also, an experiment will clearly show if the deformation depth originally established from FEA is in the right range of expectation. Once the experiment has been conducted and all first checks are verified the Model can use the data recorded from the accelerometer and compare results. This involves calculating the force on the structure and comparing it with the known load from the impact (measured by piezoelectric load cells mounted behind the rigid indenter). Obtaining comparable results in this setting would be an encouraging outcome and could potentially mean, with some further development, a sea trial could be conducted for further verification.

5.2.1 Large Double Pendulum Apparatus

In Memorial University of Newfoundland's Engineering and Applied Science faculty's structures lab, a mechanism named the Large Double Pendulum Apparatus (referred to as the "Large Pendulum") is available for experimentation purposes. A diagram of the Large Pendulum is given in Figure 5.4, where it shows the structure being studied equipped on the right pendulum carriage, and a solid, rigid-like indenter on the left pendulum carriage.

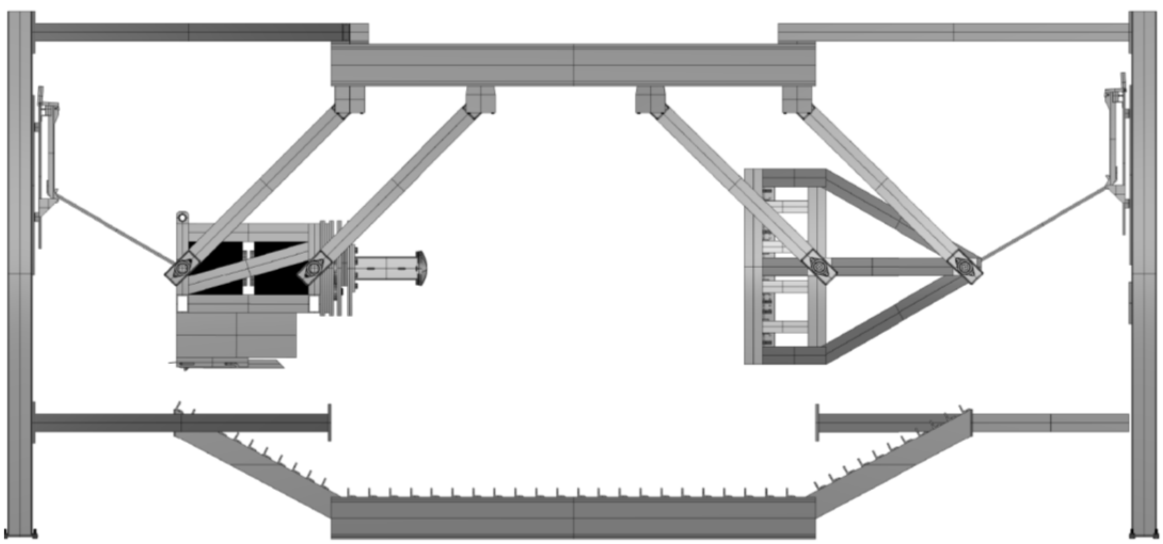

Figure 5.4: Large Double Pendulum apparatus equipped as intended for experimentation. Some supporting structure has been removed to emphasize the pendulum carriages.

The Large Pendulum has two swinging carriages which can hold a section of structure, an indenting object, or just about anything can be mounted to the steel holding frame. It has been used to study ice collisions by mounting a specimen of ice to the left carriage that then collides with the structure of choice. Piezoelectric load cells are equipped behind the indenter to measure forces experienced over the duration of collisions and to understand the impact forces during ice impacts. Accelerometers have also been attached in the past which gather valuable information about collision accelerations and speeds.

Both pendulum carriages are free to swing, and the driving force is gravity. To use the Large Pendulum, both arms are pulled backward and pinned at the desired starting pendulum angle until simultaneously released and allowed to collide at the bottom. The moment of impact occurs when both pendulum carriages are at the bottom of their swing radii and their velocity vectors are entirely horizontal toward one other.

5.2.2 Experiment Plan

The plan to validate the Model involved using the Large Pendulum to collide a nominally rigid indenter with a simple steel plate to create the same impact modelled in the computer-based validation strategy. The FEM created for the example used throughout Chapter 4 Methodology was made to replicate the conditions that would be present when it came time to validate using the Large Pendulum. This meant that the boundary conditions, collision speed, designed indenter, and the modelled event were all chosen such that the Large Pendulum could be used to validate the Model as it existed.

Designed for use with a range of experiments, including those unrelated to the author's research, an indenter was manufactured identical to the one used in FEMs discussed in Chapter 4 Methodology and Chapter 5.1 Computer-based Validation. The head of the indenter is semi-spherical in geometry and is moulded from HS100 steel which has a yield of 690 MPa. The head of the indenter is mounted to a square section of mild steel which then is mounted to the holding arm of the Large Pendulum, as shown in Figure 5.5.

Figure 5.5: Rigid indenter before mounted to the Large Pendulum (Norman 2020).

The indenter is designed to be as rigid as possible as it must impact a structure and remained unharmed. This study being conducted using the Large Pendulum is only interested in the response of the structure. By having an indenter that can effectively be called rigid for its purpose, the error in measuring delivered force to the structure can be minimized as the indenter should not absorb any energy into its own deformation.

The structure planned to be used for the validation experiment also has the same geometry as the structure used in the FEMs in Chapter 4 Methodology and Chapter 5.1 Computer-based Validation. It is a simple plate of mild steel of 328 MPa yield strength. It measures 2.05 m x 1.35 m, is 8.0 mm thick, and is not a stiffened plate, unlike a typical section of a ships hull. The reason behind using this very simplistic geometry to begin with was to eliminate any unnecessary sources of error, as including stiffeners and other supports would mean needing to account for them in the results. In order to perform the proof of concept efficiently, supporting members were not included as they would otherwise have to be considered and accounted for during the analysis stage. Also, at this stage the goal is to simply prove that the concept of the Model does work, and potential limitations due to complexity of a structure can be explored later.

The plate would have to be mounted to the Large Pendulum using the carriage, a very strong mounting mechanism. This carriage is very stiff and constrains the plate as the impact occurs. The carriage has been designed to exhibit little to no deformation itself, thus allowing the entirety of the load to contribute to deforming the plate. A diagram and photos of the plate in the carriage are shown in Figure 5.5 (a) (Quinton 2018), (b) (Norman 2020).

(a) CAD drawing of carriage with and without plate.

(b) Simple plate in the carriage holding frame intended for use during the validation experiment.

Figure 5.6: Structure and carriage designs.

The Large Pendulum would hold the indenter in a carriage and the plate mounted onto the other. With additional weight, in the form of multiple heavy steel plates, added to the indenter side of the Large Pendulum, each carriage carries a weight of approximately 4500 kg. When the swing carriages are released from the swing angle, the energy delivered to the plate with this setup would be very high. Figure 5.7 shows the Large Pendulum with the indenter and structure configured as planned for the described validation experiment.

Figure 5.7: Photo of the Large Pendulum modified as per validation experiment plan.

The plan was to mount an accelerometer to the back of the plate in the carriage and equip three piezoelectric load cells (1.2MN capacity each) behind the indenter. A collision would next be conducted with the Large Pendulum and acceleration data from the accelerometer would be used in the Model to determine the predicted force delivered to the plate. The output produced from the Model would be compared to the data recorded from the load cells to compare the accuracy of the Model in a realistic scenario.

5.3 Practical Benefits

This proposal for a hull-monitoring system can provide many practical benefits, some of which can include:

1. Increased safety at sea
2. Reduced inspection and dry-docking frequency
3. Increased lifespan of ship
4. Better situational awareness for the ship owners and operators

Safety can be increased in many respects, and primarily with regards to being made aware of potentially catastrophic damage to the hull which may not otherwise be known to those on board. If a ship had a collision that resulted in potentially threatening damage to the hull, the operator can be made aware of it immediately and make assessments based on that information. This added assurance has a potential to be a notable enhancement for managing safety of lives at sea.

Frequency of inspection and dry-docking can certainly be reduced with this system equipped to the hull as damages will be inferred as they happen. This way, unnecessary inspections will no longer be needed in the event that the severity of sustained damage is unknown to the ship owner. Assessments regarding the structural integrity of the hull can be made with a high level of confidence, which can reduce the need for dry-docking for inspection purposes.

The lifespan of a ship can be extended with the proposed system as the ship owner will be provided with the constant awareness of the ship's condition. Having the system equipped means that those onboard the ship have the ability to know when damage is serious enough that it requires repair, rather than waiting until a scheduled inspection to have it investigated. Having this awareness means that necessary repairs can be done immediately and further damage that could have resulted from being ignored can be avoided.

Another advantage is that over time, while having this system installed onboard, the ship operator will grow a more comprehensive awareness with respect to the capability of the ship. Having the experience of past collisions and their consequences the instant they happen can instil confidence in the ship operator, allowing them to understand how big of an impact the ship can safely handle.

Chapter 6 Conclusions and Recommendations

6.1 Recommendations for Future Research and Improvements

Presently, this proposed method is successful in achieving the original objective, as proven by computer-based validation. The proof of concept is assuring and enables the continuance of research on the subject. If work were to be done to improve on the current product there are a few areas of focus that could add a lot of value to the system.

The one major improvement that should first be addressed is enabling multi-angle impact capabilities. As it stands, the current Model has been tested in a single test case where the incoming load acts normal to the hull surface resulting in a perfect, symmetrical deformation pattern. In order to be functional in a real-world environment, the system would have to be capable of determining hull loads for all incident angles. As a consequence, the damage profile would also be different and changing depending on the angle. Therefore, an algorithm or altered method would have to be explored so that it can handle these types of scenarios.

Another improvement that should be investigated is the inevitability of impacts occurring at locations that are not directly in front of the accelerometer. The current model has only been calibrated for and tested as the very center of impact happens at the accelerometer. This will almost never be the case in an actual collision with ice at sea, and it is for this imminent circumstance that this capability be studied. It is likely that this will involve using the same method as is currently developed for the Model, though additional calibration will be conducted to account for the area surrounding each accelerometer, in a series of accelerometers.

If this system were to be equipped to a ship, a practical capability that it must have will be to recalibrate itself over time. The idea of this proposed system is to be able to calculate forces on a hull after impact that causes permanent damage. Therefore, after an impact the structure will change. It is for this certainty that to use this system after each impact, recalibration will have to be conducted in some way. While it is uncertain how this could take form in a commercial end-product, it is possible that a series of accelerometers will have the ability to communicate within the system to re-establish their relative positions.

As noted throughout, at this stage in the research the effects of strain-rate or strain-hardening are not accounted for. Strain-rate effects cover the changes in material response due to the rate at which the material is enlarging, while strain-hardening denotes how a material can become stronger as it endures plastic deformation (Cowper and Symonds 1957). It is recommended that strain-rate and strain-hardening is incorporated during stiffness and effective mass function calibrations. Accounting for it at this stage would eliminate error associated with the results, as well as allow for a more versatile Model.

Finally, it is recommended that after some further research and having adapted some or all of the recommendations outlined in this chapter, further testing be conducted by means of using a scale-model ship. By simulating an impact in a laboratory environment using a model ship hull, a near real-world scenario can be simulated to compare to computer-based validation results. This will allow for validation of the Model without needing to impair an actual, otherwise undamaged ship.

6.2 Conclusion

This research explored the possibility of a solution to the gap in current ship hull-monitoring technology. The objective was to develop the framework study for measuring hull stresses from an impact beyond the elastic material response limit. As existing hull-monitoring technology can only operate within the range of elasticity and relatively small deflections, there is no current method of determining the response of the hull after plastic damage has been sustained. As a result of this research, a new approach has been proposed and shown to be successful with an encouraging proof of concept.

The framework for an accelerometer-based approach to hull-monitoring has been developed and is in its first stages. As it currently stands, this method is capable of measuring accelerations on the hull during an impact and with the help of FEMs, calibrated to the ship and its purpose, it is able to accurately compute the force that was exhibited by the structure. The error associated with the results seems to be a product of the accuracy in finite element modelling, and refinement of the calibration.

At this time research has been concluded, though the potential for improvement to this proposed system is immense. Considering the suggestions discussed in the previous section, this system has a great amount of potential should the necessary research be put toward furthering the technology. Though as it stands, the concept has been proven and should be recognized as a viable method of advancing ship hull-monitoring technology.

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Appendices

Appendix A **FEA results and calculated stiffness from stiffness relationship calibration**

Sub-step	Contact Force	Center Displacement	Stiffness
units:	N	m	N/m
1	0.00E+00	0.000	0.00E+00
2	2.93E+04	0.018	1.64E+06
3	8.70E+03	0.021	4.15E+05
4	4.47E+03	0.024	1.86E+05
5	7.21E+04	0.027	2.67E+06
6	7.52E+04	0.030	2.50E+06
7	9.53E+04	0.033	2.88E+06
8	1.08E+05	0.036	2.99E+06
9	1.40E+05	0.039	3.57E+06
10	1.48E+05	0.042	3.52E+06
11	1.54E+05	0.045	3.43E+06
12	1.99E+05	0.048	4.14E+06
13	1.86E+05	0.051	3.65E+06
14	2.35E+05	0.054	4.35E+06
15	2.37E+05	0.057	4.15E+06
16	2.85E+05	0.060	4.75E+06
17	3.20E+05	0.063	5.09E+06
18	3.41E+05	0.066	5.16E+06
19	3.72E+05	0.069	5.39E+06
20	3.99E+05	0.072	5.55E+06
21	4.42E+05	0.075	5.89E+06
22	4.63E+05	0.078	5.93E+06
23	4.91E+05	0.081	6.06E+06
24	5.02E+05	0.084	5.97E+06
25	5.04E+05	0.087	5.79E+06
26	5.39E+05	0.090	5.99E+06
27	5.81E+05	0.093	6.25E+06
28	5.64E+05	0.096	5.88E+06
29	6.51E+05	0.099	6.58E+06
30	6.43E+05	0.102	6.30E+06

31	6.50E+05	0.105	6.19E+06
32	7.27E+05	0.108	6.73E+06
33	7.61E+05	0.111	6.86E+06
34	7.60E+05	0.114	6.67E+06
35	7.73E+05	0.117	6.61E+06
36	7.99E+05	0.120	6.66E+06
37	8.50E+05	0.123	6.91E+06
38	8.70E+05	0.126	6.91E+06
39	8.85E+05	0.129	6.86E+06
40	8.93E+05	0.132	6.76E+06
41	9.92E+05	0.135	7.35E+06
42	9.94E+05	0.138	7.20E+06
43	1.03E+06	0.141	7.30E+06
44	1.05E+06	0.144	7.28E+06
45	1.07E+06	0.147	7.28E+06
46	1.16E+06	0.150	7.76E+06
47	1.21E+06	0.153	7.89E+06
48	1.20E+06	0.156	7.72E+06
49	1.22E+06	0.159	7.66E+06
50	1.30E+06	0.162	8.04E+06
51	1.30E+06	0.165	7.91E+06
52	1.34E+06	0.168	7.98E+06
53	1.36E+06	0.171	7.96E+06
54	1.39E+06	0.174	7.98E+06
55	1.40E+06	0.177	7.93E+06
56	1.51E+06	0.180	8.40E+06
57	1.53E+06	0.183	8.35E+06
58	1.56E+06	0.186	8.39E+06
59	1.57E+06	0.189	8.31E+06
60	1.59E+06	0.192	8.26E+06
61	1.68E+06	0.195	8.63E+06
62	1.75E+06	0.198	8.85E+06
63	1.75E+06	0.201	8.71E+06
64	1.75E+06	0.204	8.57E+06
65	1.75E+06	0.207	8.45E+06
66	1.77E+06	0.210	8.41E+06
67	1.81E+06	0.213	8.50E+06
68	1.99E+06	0.216	9.20E+06
69	1.99E+06	0.219	9.10E+06

70	2.16E+06	0.222	9.71E+06
71	2.05E+06	0.225	9.10E+06
72	2.11E+06	0.228	9.24E+06
73	2.21E+06	0.231	9.56E+06
74	2.21E+06	0.234	9.45E+06
75	2.31E+06	0.237	9.76E+06
76	2.36E+06	0.240	9.84E+06
77	2.43E+06	0.243	9.98E+06

Appendix B **FEA results and calculated mass from mass relationship calibration**

Acceleration	Displacement	Contact Force	Stiffness	Mass
m/s^2	m	N	N/m	kg
5.00E+02	4.23E-08	8.59E+00	2.56E+00	1.72E-02
5.00E+02	3.01E-07	5.14E+01	1.82E+01	1.03E-01
5.00E+02	9.01E-07	1.19E+02	5.44E+01	2.38E-01
5.00E+02	1.91E-06	2.01E+02	1.15E+02	4.01E-01
5.00E+02	3.37E-06	2.90E+02	2.03E+02	5.80E-01
5.00E+02	5.29E-06	3.83E+02	3.20E+02	7.66E-01
5.00E+02	7.83E-06	4.81E+02	4.73E+02	9.62E-01
5.00E+02	1.07E-05	5.80E+02	6.49E+02	1.16E+00
5.00E+02	1.41E-05	6.78E+02	8.55E+02	1.36E+00
5.00E+02	1.80E-05	7.76E+02	1.09E+03	1.55E+00
5.00E+02	2.24E-05	8.74E+02	1.35E+03	1.75E+00
5.00E+02	2.73E-05	9.72E+02	1.65E+03	1.94E+00
5.00E+02	3.27E-05	1.07E+03	1.97E+03	2.14E+00
5.00E+02	3.88E-05	1.17E+03	2.35E+03	2.34E+00
5.00E+02	4.52E-05	1.27E+03	2.73E+03	2.54E+00
5.00E+02	5.21E-05	1.37E+03	3.15E+03	2.74E+00
5.00E+02	5.94E-05	1.47E+03	3.59E+03	2.94E+00
5.00E+02	6.73E-05	1.57E+03	4.07E+03	3.13E+00
5.00E+02	7.56E-05	1.67E+03	4.58E+03	3.33E+00
5.00E+02	8.45E-05	1.76E+03	5.11E+03	3.53E+00
5.00E+02	9.43E-05	1.87E+03	5.70E+03	3.73E+00
5.00E+02	1.04E-04	1.97E+03	6.30E+03	3.93E+00
5.00E+02	1.15E-04	2.07E+03	6.93E+03	4.13E+00
5.00E+02	1.25E-04	2.16E+03	7.59E+03	4.33E+00
5.00E+02	1.37E-04	2.26E+03	8.27E+03	4.52E+00
5.00E+02	1.48E-04	2.36E+03	8.99E+03	4.72E+00
5.00E+02	1.61E-04	2.46E+03	9.74E+03	4.91E+00
5.00E+02	1.74E-04	2.56E+03	1.06E+04	5.12E+00
5.00E+02	1.88E-04	2.66E+03	1.14E+04	5.32E+00
5.00E+02	2.01E-04	2.76E+03	1.22E+04	5.51E+00
5.00E+02	2.16E-04	2.86E+03	1.31E+04	5.71E+00
5.00E+02	2.31E-04	2.96E+03	1.40E+04	5.91E+00
5.00E+02	2.46E-04	3.06E+03	1.49E+04	6.10E+00

5.00E+02	2.62E-04	3.15E+03	1.59E+04	6.30E+00
5.00E+02	2.79E-04	3.25E+03	1.69E+04	6.50E+00
5.00E+02	2.96E-04	3.36E+03	1.79E+04	6.70E+00
5.00E+02	3.13E-04	3.45E+03	1.90E+04	6.90E+00
5.00E+02	3.31E-04	3.55E+03	2.01E+04	7.09E+00
5.00E+02	3.49E-04	3.65E+03	2.12E+04	7.29E+00
5.00E+02	3.68E-04	3.75E+03	2.23E+04	7.49E+00
5.00E+02	3.87E-04	3.85E+03	2.35E+04	7.68E+00
5.00E+02	4.08E-04	3.95E+03	2.48E+04	7.88E+00
5.00E+02	4.28E-04	4.05E+03	2.60E+04	8.08E+00
5.00E+02	4.49E-04	4.15E+03	2.73E+04	8.27E+00
5.00E+02	4.70E-04	4.25E+03	2.86E+04	8.47E+00
5.00E+02	4.92E-04	4.35E+03	2.99E+04	8.67E+00
5.00E+02	5.14E-04	4.45E+03	3.13E+04	8.87E+00
5.00E+02	5.37E-04	4.55E+03	3.27E+04	9.07E+00
5.00E+02	5.61E-04	4.65E+03	3.42E+04	9.27E+00
5.00E+02	5.85E-04	4.75E+03	3.56E+04	9.46E+00
5.00E+02	6.09E-04	4.85E+03	3.71E+04	9.65E+00
5.00E+02	6.34E-04	4.94E+03	3.87E+04	9.84E+00
5.00E+02	6.59E-04	5.04E+03	4.02E+04	1.00E+01
5.00E+02	6.85E-04	5.14E+03	4.18E+04	1.02E+01
5.00E+02	7.11E-04	5.24E+03	4.34E+04	1.04E+01
5.00E+02	7.39E-04	5.34E+03	4.51E+04	1.06E+01
5.00E+02	7.66E-04	5.44E+03	4.68E+04	1.08E+01
5.00E+02	7.94E-04	5.54E+03	4.85E+04	1.10E+01
5.00E+02	8.22E-04	5.65E+03	5.03E+04	1.12E+01
5.00E+02	8.51E-04	5.75E+03	5.20E+04	1.14E+01
5.00E+02	8.80E-04	5.86E+03	5.39E+04	1.16E+01
5.00E+02	9.10E-04	5.96E+03	5.57E+04	1.18E+01
5.00E+02	9.41E-04	6.06E+03	5.77E+04	1.20E+01
5.00E+02	9.72E-04	6.17E+03	5.96E+04	1.22E+01
5.00E+02	1.00E-03	6.26E+03	6.15E+04	1.24E+01
5.00E+02	1.03E-03	6.36E+03	6.35E+04	1.26E+01
5.00E+02	1.07E-03	6.46E+03	6.55E+04	1.28E+01
5.00E+02	1.10E-03	6.55E+03	6.75E+04	1.30E+01
5.00E+02	1.13E-03	6.65E+03	6.96E+04	1.31E+01
5.00E+02	1.17E-03	6.74E+03	7.18E+04	1.33E+01
5.00E+02	1.20E-03	6.84E+03	7.39E+04	1.35E+01
5.00E+02	1.24E-03	6.94E+03	7.61E+04	1.37E+01
5.00E+02	1.27E-03	7.04E+03	7.83E+04	1.39E+01
5.00E+02	1.31E-03	7.13E+03	8.05E+04	1.41E+01
5.00E+02	1.34E-03	7.23E+03	8.28E+04	1.42E+01

5.00E+02	1.38E-03	7.33E+03	8.51E+04	1.44E+01
5.00E+02	1.42E-03	7.43E+03	8.76E+04	1.46E+01
5.00E+02	1.46E-03	7.54E+03	8.99E+04	1.48E+01
5.00E+02	1.50E-03	7.64E+03	9.23E+04	1.50E+01
5.00E+02	1.53E-03	7.75E+03	9.48E+04	1.52E+01
5.00E+02	1.57E-03	7.86E+03	9.72E+04	1.54E+01
5.00E+02	1.61E-03	7.97E+03	9.97E+04	1.56E+01
5.00E+02	1.65E-03	8.09E+03	1.02E+05	1.58E+01
5.00E+02	1.69E-03	8.21E+03	1.05E+05	1.61E+01
5.00E+02	1.74E-03	8.32E+03	1.08E+05	1.63E+01
5.00E+02	1.78E-03	8.43E+03	1.10E+05	1.65E+01
5.00E+02	1.82E-03	8.54E+03	1.13E+05	1.67E+01
5.00E+02	1.86E-03	8.65E+03	1.16E+05	1.69E+01
5.00E+02	1.90E-03	8.75E+03	1.18E+05	1.71E+01
5.00E+02	1.95E-03	8.86E+03	1.21E+05	1.73E+01
5.00E+02	1.99E-03	8.97E+03	1.24E+05	1.74E+01
5.00E+02	2.04E-03	9.08E+03	1.27E+05	1.76E+01
5.00E+02	2.08E-03	9.19E+03	1.30E+05	1.78E+01
5.00E+02	2.13E-03	9.29E+03	1.33E+05	1.80E+01
5.00E+02	2.18E-03	9.40E+03	1.36E+05	1.82E+01
5.00E+02	2.22E-03	9.50E+03	1.39E+05	1.84E+01
5.00E+02	2.27E-03	9.61E+03	1.42E+05	1.86E+01
5.00E+02	2.32E-03	9.71E+03	1.45E+05	1.87E+01
5.00E+02	2.37E-03	9.81E+03	1.48E+05	1.89E+01
5.00E+02	2.42E-03	9.91E+03	1.51E+05	1.91E+01
5.00E+02	2.47E-03	1.00E+04	1.54E+05	1.92E+01
5.00E+02	2.51E-03	1.01E+04	1.57E+05	1.94E+01
5.00E+02	2.56E-03	1.02E+04	1.61E+05	1.96E+01
5.00E+02	2.62E-03	1.03E+04	1.64E+05	1.98E+01
5.00E+02	2.67E-03	1.04E+04	1.67E+05	1.99E+01
5.00E+02	2.72E-03	1.05E+04	1.71E+05	2.01E+01
5.00E+02	2.77E-03	1.06E+04	1.74E+05	2.03E+01
5.00E+02	2.82E-03	1.07E+04	1.78E+05	2.05E+01
5.00E+02	2.88E-03	1.08E+04	1.81E+05	2.06E+01
5.00E+02	2.93E-03	1.09E+04	1.85E+05	2.08E+01
5.00E+02	2.99E-03	1.10E+04	1.88E+05	2.10E+01
5.00E+02	3.04E-03	1.11E+04	1.92E+05	2.11E+01
5.00E+02	3.10E-03	1.12E+04	1.95E+05	2.13E+01
5.00E+02	3.15E-03	1.13E+04	1.99E+05	2.14E+01
5.00E+02	3.21E-03	1.14E+04	2.03E+05	2.16E+01
5.00E+02	3.27E-03	1.15E+04	2.07E+05	2.17E+01
5.00E+02	3.32E-03	1.16E+04	2.10E+05	2.19E+01

5.00E+02	3.38E-03	1.17E+04	2.14E+05	2.20E+01
5.00E+02	3.44E-03	1.18E+04	2.18E+05	2.22E+01
5.00E+02	3.50E-03	1.19E+04	2.22E+05	2.23E+01
5.00E+02	3.56E-03	1.21E+04	2.26E+05	2.25E+01
5.00E+02	3.62E-03	1.22E+04	2.30E+05	2.27E+01
5.00E+02	3.68E-03	1.23E+04	2.34E+05	2.29E+01
5.00E+02	3.74E-03	1.24E+04	2.38E+05	2.31E+01
5.00E+02	3.80E-03	1.26E+04	2.42E+05	2.33E+01
5.00E+02	3.86E-03	1.27E+04	2.46E+05	2.35E+01
5.00E+02	3.92E-03	1.28E+04	2.50E+05	2.37E+01
5.00E+02	3.99E-03	1.30E+04	2.54E+05	2.39E+01
5.00E+02	4.05E-03	1.32E+04	2.59E+05	2.43E+01
5.00E+02	4.11E-03	1.34E+04	2.63E+05	2.45E+01
5.00E+02	4.18E-03	1.35E+04	2.67E+05	2.48E+01
5.00E+02	4.24E-03	1.37E+04	2.72E+05	2.50E+01
5.00E+02	4.31E-03	1.38E+04	2.76E+05	2.52E+01
5.00E+02	4.38E-03	1.39E+04	2.81E+05	2.54E+01
5.00E+02	4.44E-03	1.41E+04	2.85E+05	2.56E+01
5.00E+02	4.51E-03	1.42E+04	2.90E+05	2.58E+01
5.00E+02	4.58E-03	1.43E+04	2.94E+05	2.60E+01
5.00E+02	4.64E-03	1.45E+04	2.99E+05	2.62E+01
5.00E+02	4.72E-03	1.46E+04	3.04E+05	2.64E+01
5.00E+02	4.78E-03	1.48E+04	3.08E+05	2.66E+01
5.00E+02	4.85E-03	1.49E+04	3.13E+05	2.68E+01
5.00E+02	4.92E-03	1.51E+04	3.18E+05	2.71E+01
5.00E+02	4.99E-03	1.52E+04	3.23E+05	2.72E+01
5.00E+02	5.06E-03	1.54E+04	3.28E+05	2.74E+01
5.00E+02	5.14E-03	1.55E+04	3.33E+05	2.76E+01
5.00E+02	5.21E-03	1.57E+04	3.38E+05	2.78E+01
5.00E+02	5.28E-03	1.58E+04	3.43E+05	2.80E+01
5.00E+02	5.36E-03	1.60E+04	3.48E+05	2.82E+01
5.00E+02	5.43E-03	1.61E+04	3.53E+05	2.84E+01
5.00E+02	5.50E-03	1.63E+04	3.58E+05	2.86E+01
5.00E+02	5.58E-03	1.64E+04	3.63E+05	2.88E+01
5.00E+02	5.65E-03	1.66E+04	3.68E+05	2.90E+01
5.00E+02	5.73E-03	1.68E+04	3.74E+05	2.93E+01
5.00E+02	5.81E-03	1.69E+04	3.79E+05	2.95E+01
5.00E+02	5.88E-03	1.71E+04	3.84E+05	2.97E+01
5.00E+02	5.96E-03	1.73E+04	3.90E+05	2.99E+01
5.00E+02	6.04E-03	1.74E+04	3.95E+05	3.01E+01
5.00E+02	6.12E-03	1.76E+04	4.00E+05	3.03E+01
5.00E+02	6.19E-03	1.78E+04	4.06E+05	3.06E+01

5.00E+02	6.28E-03	1.80E+04	4.12E+05	3.08E+01
5.00E+02	6.36E-03	1.81E+04	4.17E+05	3.09E+01
5.00E+02	6.44E-03	1.82E+04	4.23E+05	3.10E+01
5.00E+02	6.52E-03	1.84E+04	4.29E+05	3.12E+01
5.00E+02	6.60E-03	1.86E+04	4.34E+05	3.14E+01
5.00E+02	6.68E-03	1.87E+04	4.40E+05	3.16E+01
5.00E+02	6.76E-03	1.89E+04	4.46E+05	3.18E+01
5.00E+02	6.85E-03	1.90E+04	4.52E+05	3.19E+01
5.00E+02	6.93E-03	1.92E+04	4.58E+05	3.20E+01
5.00E+02	7.01E-03	1.94E+04	4.64E+05	3.23E+01
5.00E+02	7.10E-03	1.96E+04	4.70E+05	3.25E+01
5.00E+02	7.18E-03	1.97E+04	4.76E+05	3.26E+01
5.00E+02	7.26E-03	1.99E+04	4.82E+05	3.29E+01
5.00E+02	7.35E-03	2.00E+04	4.88E+05	3.28E+01
5.00E+02	7.44E-03	2.03E+04	4.94E+05	3.32E+01
5.00E+02	7.53E-03	2.05E+04	5.01E+05	3.34E+01
5.00E+02	7.61E-03	2.06E+04	5.07E+05	3.35E+01
5.00E+02	7.70E-03	2.08E+04	5.13E+05	3.36E+01
5.00E+02	7.79E-03	2.09E+04	5.19E+05	3.37E+01
5.00E+02	7.88E-03	2.11E+04	5.26E+05	3.38E+01
5.00E+02	7.96E-03	2.12E+04	5.32E+05	3.39E+01
5.00E+02	8.06E-03	2.14E+04	5.39E+05	3.42E+01
5.00E+02	8.15E-03	2.16E+04	5.45E+05	3.44E+01
5.00E+02	8.24E-03	2.18E+04	5.52E+05	3.45E+01
5.00E+02	8.33E-03	2.19E+04	5.59E+05	3.45E+01
5.00E+02	8.42E-03	2.21E+04	5.65E+05	3.47E+01
5.00E+02	8.51E-03	2.23E+04	5.72E+05	3.48E+01
5.00E+02	8.61E-03	2.26E+04	5.79E+05	3.52E+01
5.00E+02	8.70E-03	2.27E+04	5.86E+05	3.53E+01
5.00E+02	8.79E-03	2.29E+04	5.93E+05	3.53E+01
5.00E+02	8.89E-03	2.29E+04	6.00E+05	3.52E+01
5.00E+02	8.98E-03	2.31E+04	6.06E+05	3.54E+01
5.00E+02	9.08E-03	2.33E+04	6.13E+05	3.55E+01
5.00E+02	9.17E-03	2.36E+04	6.20E+05	3.59E+01
5.00E+02	9.27E-03	2.39E+04	6.28E+05	3.61E+01
5.00E+02	9.37E-03	2.41E+04	6.35E+05	3.63E+01
5.00E+02	9.47E-03	2.43E+04	6.42E+05	3.65E+01
5.00E+02	9.56E-03	2.45E+04	6.49E+05	3.65E+01
5.00E+02	9.66E-03	2.46E+04	6.57E+05	3.65E+01
5.00E+02	9.76E-03	2.48E+04	6.64E+05	3.66E+01
5.00E+02	9.86E-03	2.51E+04	6.71E+05	3.69E+01
5.00E+02	9.96E-03	2.53E+04	6.79E+05	3.71E+01

5.00E+02	1.01E-02	2.55E+04	6.87E+05	3.72E+01
5.00E+02	1.02E-02	2.56E+04	6.94E+05	3.71E+01
5.00E+02	1.03E-02	2.59E+04	7.02E+05	3.75E+01
5.00E+02	1.04E-02	2.62E+04	7.09E+05	3.76E+01
5.00E+02	1.05E-02	2.64E+04	7.17E+05	3.78E+01
5.00E+02	1.06E-02	2.66E+04	7.25E+05	3.80E+01
5.00E+02	1.07E-02	2.69E+04	7.33E+05	3.82E+01
5.00E+02	1.08E-02	2.71E+04	7.41E+05	3.82E+01
5.00E+02	1.09E-02	2.73E+04	7.49E+05	3.84E+01
5.00E+02	1.10E-02	2.75E+04	7.57E+05	3.85E+01
5.00E+02	1.11E-02	2.78E+04	7.65E+05	3.87E+01
5.00E+02	1.12E-02	2.81E+04	7.73E+05	3.88E+01
5.00E+02	1.13E-02	2.82E+04	7.81E+05	3.87E+01
5.00E+02	1.14E-02	2.85E+04	7.89E+05	3.89E+01
5.00E+02	1.15E-02	2.87E+04	7.97E+05	3.90E+01
5.00E+02	1.16E-02	2.89E+04	8.06E+05	3.90E+01
5.00E+02	1.17E-02	2.91E+04	8.14E+05	3.90E+01
5.00E+02	1.19E-02	2.94E+04	8.22E+05	3.93E+01
5.00E+02	1.20E-02	2.95E+04	8.31E+05	3.92E+01
5.00E+02	1.21E-02	2.99E+04	8.39E+05	3.95E+01
5.00E+02	1.22E-02	3.00E+04	8.48E+05	3.94E+01
5.00E+02	1.23E-02	3.04E+04	8.56E+05	3.98E+01
5.00E+02	1.24E-02	3.07E+04	8.65E+05	3.99E+01
5.00E+02	1.25E-02	3.08E+04	8.74E+05	3.96E+01
5.00E+02	1.26E-02	3.10E+04	8.82E+05	3.98E+01
5.00E+02	1.28E-02	3.13E+04	8.91E+05	3.99E+01
5.00E+02	1.29E-02	3.16E+04	9.00E+05	4.00E+01
5.00E+02	1.30E-02	3.18E+04	9.09E+05	3.99E+01
5.00E+02	1.31E-02	3.19E+04	9.18E+05	3.97E+01
5.00E+02	1.32E-02	3.22E+04	9.27E+05	3.99E+01
5.00E+02	1.33E-02	3.25E+04	9.36E+05	4.01E+01
5.00E+02	1.34E-02	3.27E+04	9.45E+05	4.00E+01
5.00E+02	1.36E-02	3.29E+04	9.54E+05	4.00E+01
5.00E+02	1.37E-02	3.32E+04	9.63E+05	4.01E+01
5.00E+02	1.38E-02	3.33E+04	9.73E+05	3.98E+01
5.00E+02	1.39E-02	3.37E+04	9.82E+05	4.02E+01
5.00E+02	1.40E-02	3.40E+04	9.91E+05	4.02E+01
5.00E+02	1.42E-02	3.42E+04	1.00E+06	4.00E+01
5.00E+02	1.43E-02	3.45E+04	1.01E+06	4.01E+01
5.00E+02	1.44E-02	3.48E+04	1.02E+06	4.03E+01
5.00E+02	1.45E-02	3.50E+04	1.03E+06	4.01E+01
5.00E+02	1.46E-02	3.53E+04	1.04E+06	4.02E+01

5.00E+02	1.48E-02	3.55E+04	1.05E+06	4.00E+01
5.00E+02	1.49E-02	3.59E+04	1.06E+06	4.02E+01
5.00E+02	1.50E-02	3.63E+04	1.07E+06	4.06E+01
5.00E+02	1.51E-02	3.66E+04	1.08E+06	4.06E+01
5.00E+02	1.53E-02	3.69E+04	1.09E+06	4.07E+01
5.00E+02	1.54E-02	3.72E+04	1.10E+06	4.08E+01
5.00E+02	1.55E-02	3.75E+04	1.11E+06	4.07E+01
5.00E+02	1.56E-02	3.79E+04	1.12E+06	4.08E+01
5.00E+02	1.58E-02	3.82E+04	1.13E+06	4.08E+01
5.00E+02	1.59E-02	3.84E+04	1.14E+06	4.07E+01
5.00E+02	1.60E-02	3.87E+04	1.15E+06	4.06E+01
5.00E+02	1.61E-02	3.91E+04	1.16E+06	4.10E+01
5.00E+02	1.63E-02	3.94E+04	1.17E+06	4.07E+01
5.00E+02	1.64E-02	3.98E+04	1.18E+06	4.09E+01
5.00E+02	1.65E-02	4.02E+04	1.19E+06	4.11E+01
5.00E+02	1.67E-02	4.03E+04	1.20E+06	4.06E+01
5.00E+02	1.68E-02	4.08E+04	1.21E+06	4.10E+01
5.00E+02	1.69E-02	4.13E+04	1.22E+06	4.14E+01
5.00E+02	1.70E-02	4.15E+04	1.23E+06	4.10E+01
5.00E+02	1.72E-02	4.18E+04	1.24E+06	4.11E+01
5.00E+02	1.73E-02	4.24E+04	1.25E+06	4.15E+01
5.00E+02	1.74E-02	4.27E+04	1.26E+06	4.14E+01
5.00E+02	1.76E-02	4.27E+04	1.27E+06	4.07E+01
5.00E+02	1.77E-02	4.32E+04	1.28E+06	4.10E+01
5.00E+02	1.78E-02	4.37E+04	1.29E+06	4.12E+01
5.00E+02	1.80E-02	4.41E+04	1.30E+06	4.13E+01
5.00E+02	1.81E-02	4.46E+04	1.32E+06	4.15E+01
5.00E+02	1.83E-02	4.50E+04	1.33E+06	4.15E+01
5.00E+02	1.84E-02	4.52E+04	1.34E+06	4.11E+01
5.00E+02	1.85E-02	4.56E+04	1.35E+06	4.12E+01
5.00E+02	1.87E-02	4.61E+04	1.36E+06	4.14E+01
5.00E+02	1.88E-02	4.65E+04	1.37E+06	4.15E+01
5.00E+02	1.89E-02	4.69E+04	1.38E+06	4.15E+01
5.00E+02	1.91E-02	4.73E+04	1.39E+06	4.14E+01
5.00E+02	1.92E-02	4.77E+04	1.41E+06	4.13E+01
5.00E+02	1.94E-02	4.81E+04	1.42E+06	4.13E+01
5.00E+02	1.95E-02	4.86E+04	1.43E+06	4.15E+01
5.00E+02	1.96E-02	4.91E+04	1.44E+06	4.17E+01
5.00E+02	1.98E-02	4.99E+04	1.45E+06	4.23E+01
5.00E+02	1.99E-02	5.02E+04	1.46E+06	4.22E+01
5.00E+02	2.01E-02	5.09E+04	1.48E+06	4.25E+01
5.00E+02	2.02E-02	5.10E+04	1.49E+06	4.19E+01

5.00E+02	2.04E-02	5.18E+04	1.50E+06	4.25E+01
5.00E+02	2.05E-02	5.23E+04	1.51E+06	4.27E+01
5.00E+02	2.07E-02	5.27E+04	1.52E+06	4.26E+01
5.00E+02	2.08E-02	5.33E+04	1.53E+06	4.27E+01
5.00E+02	2.09E-02	5.37E+04	1.55E+06	4.27E+01
5.00E+02	2.11E-02	5.43E+04	1.56E+06	4.27E+01
5.00E+02	2.12E-02	5.49E+04	1.57E+06	4.31E+01
5.00E+02	2.14E-02	5.56E+04	1.58E+06	4.33E+01
5.00E+02	2.15E-02	5.61E+04	1.60E+06	4.34E+01
5.00E+02	2.17E-02	5.67E+04	1.61E+06	4.37E+01
5.00E+02	2.18E-02	5.72E+04	1.62E+06	4.37E+01
5.00E+02	2.20E-02	5.77E+04	1.63E+06	4.36E+01
5.00E+02	2.21E-02	5.82E+04	1.64E+06	4.36E+01
5.00E+02	2.23E-02	5.88E+04	1.66E+06	4.37E+01
5.00E+02	2.25E-02	5.95E+04	1.67E+06	4.40E+01
5.00E+02	2.26E-02	6.02E+04	1.68E+06	4.43E+01
5.00E+02	2.28E-02	6.05E+04	1.70E+06	4.39E+01
5.00E+02	2.29E-02	6.16E+04	1.71E+06	4.50E+01
5.00E+02	2.31E-02	6.19E+04	1.72E+06	4.45E+01
5.00E+02	2.32E-02	6.28E+04	1.73E+06	4.51E+01
5.00E+02	2.34E-02	6.34E+04	1.75E+06	4.52E+01
5.00E+02	2.35E-02	6.39E+04	1.76E+06	4.49E+01
5.00E+02	2.37E-02	6.48E+04	1.77E+06	4.57E+01
5.00E+02	2.38E-02	6.52E+04	1.78E+06	4.54E+01
5.00E+02	2.40E-02	6.59E+04	1.80E+06	4.54E+01
5.00E+02	2.41E-02	6.64E+04	1.81E+06	4.54E+01
5.00E+02	2.43E-02	6.71E+04	1.82E+06	4.56E+01
5.00E+02	2.45E-02	6.81E+04	1.84E+06	4.63E+01
5.00E+02	2.46E-02	6.89E+04	1.85E+06	4.67E+01
5.00E+02	2.48E-02	6.96E+04	1.86E+06	4.67E+01
5.00E+02	2.49E-02	7.04E+04	1.88E+06	4.71E+01
5.00E+02	2.51E-02	7.19E+04	1.89E+06	4.88E+01
5.00E+02	2.53E-02	7.27E+04	1.90E+06	4.92E+01
5.00E+02	2.54E-02	7.32E+04	1.92E+06	4.89E+01
5.00E+02	2.56E-02	7.42E+04	1.93E+06	4.96E+01
5.00E+02	2.58E-02	7.48E+04	1.94E+06	4.95E+01
5.00E+02	2.59E-02	7.60E+04	1.96E+06	5.05E+01
5.00E+02	2.61E-02	7.68E+04	1.97E+06	5.08E+01
5.00E+02	2.62E-02	7.84E+04	1.98E+06	5.26E+01
5.00E+02	2.64E-02	7.93E+04	2.00E+06	5.31E+01
5.00E+02	2.66E-02	8.02E+04	2.01E+06	5.34E+01
5.00E+02	2.67E-02	8.12E+04	2.03E+06	5.40E+01

5.00E+02	2.69E-02	8.28E+04	2.04E+06	5.59E+01
5.00E+02	2.71E-02	8.32E+04	2.05E+06	5.52E+01
5.00E+02	2.72E-02	8.44E+04	2.07E+06	5.61E+01
5.00E+02	2.74E-02	8.59E+04	2.08E+06	5.78E+01
5.00E+02	2.76E-02	8.68E+04	2.10E+06	5.79E+01
5.00E+02	2.77E-02	8.84E+04	2.11E+06	5.97E+01
5.00E+02	2.79E-02	8.90E+04	2.12E+06	5.94E+01
5.00E+02	2.81E-02	9.07E+04	2.14E+06	6.13E+01
5.00E+02	2.83E-02	9.20E+04	2.15E+06	6.24E+01
5.00E+02	2.84E-02	9.26E+04	2.17E+06	6.19E+01
5.00E+02	2.86E-02	9.41E+04	2.18E+06	6.34E+01
5.00E+02	2.88E-02	9.51E+04	2.19E+06	6.39E+01
5.00E+02	2.89E-02	9.64E+04	2.21E+06	6.49E+01
5.00E+02	2.91E-02	9.72E+04	2.22E+06	6.49E+01
5.00E+02	2.93E-02	9.87E+04	2.24E+06	6.62E+01
5.00E+02	2.95E-02	9.98E+04	2.25E+06	6.68E+01
5.00E+02	2.96E-02	1.01E+05	2.27E+06	6.72E+01
5.00E+02	2.98E-02	1.02E+05	2.28E+06	6.77E+01
5.00E+02	3.00E-02	1.03E+05	2.30E+06	6.86E+01
5.00E+02	3.02E-02	1.04E+05	2.31E+06	6.93E+01
5.00E+02	3.03E-02	1.06E+05	2.33E+06	6.99E+01
5.00E+02	3.05E-02	1.07E+05	2.34E+06	7.03E+01
5.00E+02	3.07E-02	1.08E+05	2.35E+06	7.11E+01
5.00E+02	3.09E-02	1.09E+05	2.37E+06	7.14E+01
5.00E+02	3.10E-02	1.10E+05	2.38E+06	7.21E+01
5.00E+02	3.12E-02	1.12E+05	2.40E+06	7.33E+01
5.00E+02	3.14E-02	1.12E+05	2.41E+06	7.34E+01
5.00E+02	3.16E-02	1.14E+05	2.43E+06	7.40E+01
5.00E+02	3.18E-02	1.15E+05	2.44E+06	7.52E+01
5.00E+02	3.19E-02	1.16E+05	2.46E+06	7.60E+01
5.00E+02	3.21E-02	1.17E+05	2.47E+06	7.61E+01
5.00E+02	3.23E-02	1.19E+05	2.49E+06	7.80E+01
5.00E+02	3.25E-02	1.20E+05	2.50E+06	7.75E+01
5.00E+02	3.27E-02	1.22E+05	2.52E+06	7.92E+01
5.00E+02	3.28E-02	1.23E+05	2.53E+06	7.87E+01
5.00E+02	3.30E-02	1.24E+05	2.55E+06	8.01E+01
5.00E+02	3.32E-02	1.25E+05	2.56E+06	7.92E+01
5.00E+02	3.34E-02	1.27E+05	2.58E+06	8.25E+01
5.00E+02	3.36E-02	1.28E+05	2.59E+06	8.19E+01
5.00E+02	3.38E-02	1.30E+05	2.61E+06	8.44E+01
5.00E+02	3.39E-02	1.31E+05	2.62E+06	8.44E+01
5.00E+02	3.41E-02	1.33E+05	2.64E+06	8.64E+01

5.00E+02	3.43E-02	1.34E+05	2.65E+06	8.60E+01
5.00E+02	3.45E-02	1.37E+05	2.67E+06	8.89E+01
5.00E+02	3.47E-02	1.38E+05	2.69E+06	8.92E+01
5.00E+02	3.49E-02	1.39E+05	2.70E+06	9.05E+01
5.00E+02	3.51E-02	1.41E+05	2.72E+06	9.12E+01
5.00E+02	3.53E-02	1.42E+05	2.73E+06	9.23E+01
5.00E+02	3.55E-02	1.44E+05	2.75E+06	9.35E+01
5.00E+02	3.56E-02	1.46E+05	2.76E+06	9.47E+01
5.00E+02	3.58E-02	1.48E+05	2.78E+06	9.64E+01
5.00E+02	3.60E-02	1.49E+05	2.79E+06	9.72E+01
5.00E+02	3.62E-02	1.51E+05	2.81E+06	9.84E+01
5.00E+02	3.64E-02	1.53E+05	2.82E+06	1.00E+02
5.00E+02	3.66E-02	1.54E+05	2.84E+06	1.00E+02
5.00E+02	3.68E-02	1.56E+05	2.85E+06	1.03E+02
5.00E+02	3.70E-02	1.58E+05	2.87E+06	1.03E+02
5.00E+02	3.72E-02	1.59E+05	2.89E+06	1.04E+02
5.00E+02	3.74E-02	1.61E+05	2.90E+06	1.06E+02
5.00E+02	3.75E-02	1.62E+05	2.92E+06	1.05E+02
5.00E+02	3.77E-02	1.65E+05	2.93E+06	1.09E+02
5.00E+02	3.79E-02	1.66E+05	2.95E+06	1.08E+02
5.00E+02	3.81E-02	1.68E+05	2.96E+06	1.10E+02
5.00E+02	3.83E-02	1.69E+05	2.98E+06	1.09E+02
5.00E+02	3.85E-02	1.71E+05	3.00E+06	1.11E+02
5.00E+02	3.87E-02	1.73E+05	3.01E+06	1.12E+02
5.00E+02	3.89E-02	1.74E+05	3.03E+06	1.13E+02
5.00E+02	3.91E-02	1.76E+05	3.04E+06	1.14E+02
5.00E+02	3.93E-02	1.77E+05	3.06E+06	1.13E+02
5.00E+02	3.95E-02	1.80E+05	3.07E+06	1.17E+02
5.00E+02	3.97E-02	1.81E+05	3.09E+06	1.16E+02
5.00E+02	3.99E-02	1.83E+05	3.11E+06	1.19E+02
5.00E+02	4.01E-02	1.84E+05	3.12E+06	1.19E+02
5.00E+02	4.03E-02	1.87E+05	3.14E+06	1.21E+02
5.00E+02	4.05E-02	1.88E+05	3.15E+06	1.21E+02
5.00E+02	4.07E-02	1.91E+05	3.17E+06	1.24E+02
5.00E+02	4.08E-02	1.92E+05	3.18E+06	1.24E+02
5.00E+02	4.11E-02	1.95E+05	3.20E+06	1.27E+02
5.00E+02	4.12E-02	1.96E+05	3.21E+06	1.27E+02
5.00E+02	4.14E-02	1.98E+05	3.23E+06	1.29E+02
5.00E+02	4.16E-02	1.99E+05	3.25E+06	1.28E+02
5.00E+02	4.18E-02	2.02E+05	3.26E+06	1.31E+02
5.00E+02	4.20E-02	2.03E+05	3.28E+06	1.30E+02
5.00E+02	4.22E-02	2.05E+05	3.29E+06	1.33E+02

5.00E+02	4.24E-02	2.06E+05	3.31E+06	1.31E+02
5.00E+02	4.26E-02	2.09E+05	3.32E+06	1.35E+02
5.00E+02	4.28E-02	2.10E+05	3.34E+06	1.33E+02
5.00E+02	4.30E-02	2.12E+05	3.36E+06	1.35E+02
5.00E+02	4.32E-02	2.14E+05	3.37E+06	1.36E+02
5.00E+02	4.34E-02	2.16E+05	3.39E+06	1.37E+02
5.00E+02	4.36E-02	2.18E+05	3.40E+06	1.39E+02
5.00E+02	4.38E-02	2.19E+05	3.42E+06	1.39E+02
5.00E+02	4.40E-02	2.22E+05	3.44E+06	1.42E+02
5.00E+02	4.42E-02	2.23E+05	3.45E+06	1.42E+02
5.00E+02	4.45E-02	2.26E+05	3.47E+06	1.45E+02
5.00E+02	4.47E-02	2.28E+05	3.48E+06	1.44E+02
5.00E+02	4.49E-02	2.30E+05	3.50E+06	1.46E+02
5.00E+02	4.51E-02	2.33E+05	3.51E+06	1.49E+02
5.00E+02	4.53E-02	2.34E+05	3.53E+06	1.48E+02
5.00E+02	4.55E-02	2.37E+05	3.55E+06	1.51E+02
5.00E+02	4.57E-02	2.39E+05	3.56E+06	1.53E+02
5.00E+02	4.59E-02	2.41E+05	3.58E+06	1.53E+02
5.00E+02	4.61E-02	2.42E+05	3.59E+06	1.54E+02
5.00E+02	4.63E-02	2.46E+05	3.61E+06	1.57E+02
5.00E+02	4.65E-02	2.46E+05	3.63E+06	1.55E+02
5.00E+02	4.67E-02	2.50E+05	3.64E+06	1.59E+02
5.00E+02	4.69E-02	2.51E+05	3.66E+06	1.59E+02
5.00E+02	4.71E-02	2.53E+05	3.67E+06	1.60E+02
5.00E+02	4.74E-02	2.56E+05	3.69E+06	1.62E+02
5.00E+02	4.76E-02	2.57E+05	3.71E+06	1.61E+02
5.00E+02	4.78E-02	2.60E+05	3.72E+06	1.65E+02
5.00E+02	4.80E-02	2.62E+05	3.74E+06	1.65E+02
5.00E+02	4.82E-02	2.64E+05	3.75E+06	1.67E+02
5.00E+02	4.84E-02	2.67E+05	3.77E+06	1.69E+02
5.00E+02	4.86E-02	2.69E+05	3.79E+06	1.70E+02
5.00E+02	4.89E-02	2.71E+05	3.80E+06	1.70E+02
5.00E+02	4.91E-02	2.72E+05	3.82E+06	1.70E+02
5.00E+02	4.93E-02	2.75E+05	3.83E+06	1.72E+02
5.00E+02	4.95E-02	2.77E+05	3.85E+06	1.73E+02
5.00E+02	4.97E-02	2.79E+05	3.87E+06	1.74E+02
5.00E+02	4.99E-02	2.80E+05	3.88E+06	1.72E+02
5.00E+02	5.02E-02	2.83E+05	3.90E+06	1.76E+02
5.00E+02	5.04E-02	2.85E+05	3.92E+06	1.77E+02
5.00E+02	5.06E-02	2.87E+05	3.93E+06	1.76E+02
5.00E+02	5.08E-02	2.89E+05	3.95E+06	1.77E+02
5.00E+02	5.10E-02	2.92E+05	3.96E+06	1.79E+02

5.00E+02	5.12E-02	2.93E+05	3.98E+06	1.77E+02
5.00E+02	5.15E-02	2.96E+05	4.00E+06	1.80E+02
5.00E+02	5.17E-02	2.98E+05	4.01E+06	1.81E+02
5.00E+02	5.19E-02	2.99E+05	4.03E+06	1.80E+02
5.00E+02	5.21E-02	3.02E+05	4.04E+06	1.83E+02
5.00E+02	5.24E-02	3.06E+05	4.06E+06	1.86E+02
5.00E+02	5.26E-02	3.07E+05	4.08E+06	1.84E+02
5.00E+02	5.28E-02	3.09E+05	4.09E+06	1.86E+02
5.00E+02	5.30E-02	3.13E+05	4.11E+06	1.90E+02
5.00E+02	5.33E-02	3.14E+05	4.12E+06	1.89E+02
5.00E+02	5.35E-02	3.17E+05	4.14E+06	1.91E+02
5.00E+02	5.37E-02	3.21E+05	4.16E+06	1.95E+02
5.00E+02	5.39E-02	3.22E+05	4.17E+06	1.94E+02
5.00E+02	5.42E-02	3.26E+05	4.19E+06	1.97E+02
5.00E+02	5.44E-02	3.28E+05	4.21E+06	1.98E+02
5.00E+02	5.46E-02	3.29E+05	4.22E+06	1.97E+02
5.00E+02	5.48E-02	3.33E+05	4.24E+06	2.02E+02
5.00E+02	5.51E-02	3.35E+05	4.25E+06	2.02E+02
5.00E+02	5.53E-02	3.37E+05	4.27E+06	2.01E+02
5.00E+02	5.55E-02	3.40E+05	4.29E+06	2.04E+02
5.00E+02	5.58E-02	3.43E+05	4.30E+06	2.06E+02
5.00E+02	5.60E-02	3.45E+05	4.32E+06	2.06E+02
5.00E+02	5.62E-02	3.48E+05	4.33E+06	2.08E+02
5.00E+02	5.65E-02	3.50E+05	4.35E+06	2.10E+02
5.00E+02	5.67E-02	3.52E+05	4.37E+06	2.09E+02
5.00E+02	5.69E-02	3.56E+05	4.38E+06	2.13E+02
5.00E+02	5.72E-02	3.57E+05	4.40E+06	2.11E+02
5.00E+02	5.74E-02	3.61E+05	4.41E+06	2.15E+02
5.00E+02	5.76E-02	3.65E+05	4.43E+06	2.20E+02
5.00E+02	5.79E-02	3.66E+05	4.44E+06	2.18E+02
5.00E+02	5.81E-02	3.68E+05	4.46E+06	2.17E+02
5.00E+02	5.83E-02	3.72E+05	4.48E+06	2.22E+02
5.00E+02	5.86E-02	3.75E+05	4.49E+06	2.23E+02
5.00E+02	5.88E-02	3.76E+05	4.51E+06	2.22E+02
5.00E+02	5.90E-02	3.81E+05	4.52E+06	2.28E+02
5.00E+02	5.93E-02	3.84E+05	4.54E+06	2.30E+02
5.00E+02	5.95E-02	3.85E+05	4.56E+06	2.28E+02
5.00E+02	5.97E-02	3.90E+05	4.57E+06	2.34E+02
5.00E+02	6.00E-02	3.93E+05	4.59E+06	2.35E+02
5.00E+02	6.02E-02	3.94E+05	4.60E+06	2.35E+02
5.00E+02	6.05E-02	4.00E+05	4.62E+06	2.41E+02
5.00E+02	6.07E-02	4.02E+05	4.63E+06	2.41E+02

5.00E+02	6.09E-02	4.04E+05	4.65E+06	2.41E+02
5.00E+02	6.12E-02	4.08E+05	4.67E+06	2.45E+02
5.00E+02	6.14E-02	4.12E+05	4.68E+06	2.49E+02
5.00E+02	6.17E-02	4.14E+05	4.70E+06	2.49E+02
5.00E+02	6.19E-02	4.16E+05	4.71E+06	2.50E+02
5.00E+02	6.21E-02	4.20E+05	4.73E+06	2.53E+02
5.00E+02	6.24E-02	4.23E+05	4.74E+06	2.55E+02
5.00E+02	6.26E-02	4.27E+05	4.76E+06	2.58E+02
5.00E+02	6.29E-02	4.30E+05	4.77E+06	2.60E+02
5.00E+02	6.31E-02	4.34E+05	4.79E+06	2.64E+02
5.00E+02	6.34E-02	4.36E+05	4.80E+06	2.64E+02
5.00E+02	6.36E-02	4.40E+05	4.82E+06	2.67E+02
5.00E+02	6.38E-02	4.43E+05	4.83E+06	2.69E+02
5.00E+02	6.41E-02	4.47E+05	4.85E+06	2.73E+02
5.00E+02	6.43E-02	4.49E+05	4.86E+06	2.72E+02
5.00E+02	6.46E-02	4.54E+05	4.88E+06	2.79E+02
5.00E+02	6.48E-02	4.57E+05	4.90E+06	2.79E+02
5.00E+02	6.51E-02	4.60E+05	4.91E+06	2.80E+02
5.00E+02	6.53E-02	4.62E+05	4.93E+06	2.81E+02
5.00E+02	6.56E-02	4.68E+05	4.94E+06	2.89E+02
5.00E+02	6.58E-02	4.71E+05	4.96E+06	2.89E+02
5.00E+02	6.60E-02	4.73E+05	4.97E+06	2.90E+02
5.00E+02	6.63E-02	4.78E+05	4.99E+06	2.94E+02
5.00E+02	6.66E-02	4.82E+05	5.00E+06	2.99E+02
5.00E+02	6.68E-02	4.84E+05	5.02E+06	2.97E+02
5.00E+02	6.70E-02	4.88E+05	5.03E+06	3.02E+02
5.00E+02	6.73E-02	4.94E+05	5.04E+06	3.08E+02
5.00E+02	6.75E-02	4.94E+05	5.06E+06	3.04E+02
5.00E+02	6.78E-02	4.98E+05	5.07E+06	3.08E+02
5.00E+02	6.80E-02	5.06E+05	5.09E+06	3.19E+02
5.00E+02	6.83E-02	5.07E+05	5.10E+06	3.17E+02
5.00E+02	6.85E-02	5.08E+05	5.12E+06	3.14E+02
5.00E+02	6.88E-02	5.17E+05	5.13E+06	3.27E+02
5.00E+02	6.91E-02	5.18E+05	5.15E+06	3.25E+02
5.00E+02	6.93E-02	5.19E+05	5.16E+06	3.23E+02
5.00E+02	6.96E-02	5.28E+05	5.18E+06	3.36E+02
5.00E+02	6.98E-02	5.30E+05	5.19E+06	3.36E+02
5.00E+02	7.01E-02	5.30E+05	5.21E+06	3.31E+02
5.00E+02	7.03E-02	5.37E+05	5.22E+06	3.40E+02
5.00E+02	7.06E-02	5.42E+05	5.23E+06	3.46E+02
5.00E+02	7.08E-02	5.42E+05	5.25E+06	3.40E+02
5.00E+02	7.11E-02	5.49E+05	5.26E+06	3.50E+02

5.00E+02	7.13E-02	5.53E+05	5.28E+06	3.53E+02
5.00E+02	7.16E-02	5.54E+05	5.29E+06	3.51E+02
5.00E+02	7.19E-02	5.58E+05	5.31E+06	3.53E+02
5.00E+02	7.21E-02	5.65E+05	5.32E+06	3.63E+02
5.00E+02	7.24E-02	5.66E+05	5.33E+06	3.60E+02
5.00E+02	7.26E-02	5.69E+05	5.35E+06	3.61E+02
5.00E+02	7.29E-02	5.75E+05	5.36E+06	3.69E+02
5.00E+02	7.32E-02	5.79E+05	5.38E+06	3.71E+02
5.00E+02	7.34E-02	5.80E+05	5.39E+06	3.69E+02
5.00E+02	7.37E-02	5.87E+05	5.40E+06	3.77E+02
5.00E+02	7.39E-02	5.90E+05	5.42E+06	3.79E+02
5.00E+02	7.42E-02	5.92E+05	5.43E+06	3.78E+02
5.00E+02	7.44E-02	5.96E+05	5.44E+06	3.82E+02
5.00E+02	7.47E-02	6.02E+05	5.46E+06	3.88E+02
5.00E+02	7.50E-02	6.02E+05	5.47E+06	3.84E+02
5.00E+02	7.52E-02	6.09E+05	5.49E+06	3.93E+02
5.00E+02	7.55E-02	6.11E+05	5.50E+06	3.93E+02
5.00E+02	7.58E-02	6.15E+05	5.51E+06	3.94E+02
5.00E+02	7.60E-02	6.19E+05	5.53E+06	3.98E+02
5.00E+02	7.63E-02	6.23E+05	5.54E+06	4.01E+02
5.00E+02	7.65E-02	6.26E+05	5.55E+06	4.02E+02
5.00E+02	7.68E-02	6.31E+05	5.57E+06	4.07E+02
5.00E+02	7.71E-02	6.34E+05	5.58E+06	4.08E+02
5.00E+02	7.73E-02	6.38E+05	5.59E+06	4.11E+02
5.00E+02	7.76E-02	6.41E+05	5.61E+06	4.12E+02
5.00E+02	7.79E-02	6.44E+05	5.62E+06	4.13E+02
5.00E+02	7.81E-02	6.48E+05	5.63E+06	4.17E+02
5.00E+02	7.84E-02	6.52E+05	5.65E+06	4.19E+02
5.00E+02	7.87E-02	6.57E+05	5.66E+06	4.23E+02
5.00E+02	7.89E-02	6.60E+05	5.67E+06	4.24E+02
5.00E+02	7.92E-02	6.62E+05	5.68E+06	4.23E+02
5.00E+02	7.95E-02	6.68E+05	5.70E+06	4.31E+02
5.00E+02	7.97E-02	6.69E+05	5.71E+06	4.28E+02
5.00E+02	8.00E-02	6.73E+05	5.72E+06	4.30E+02
5.00E+02	8.03E-02	6.77E+05	5.73E+06	4.32E+02
5.00E+02	8.05E-02	6.82E+05	5.75E+06	4.38E+02
5.00E+02	8.08E-02	6.84E+05	5.76E+06	4.36E+02
5.00E+02	8.11E-02	6.88E+05	5.77E+06	4.41E+02
5.00E+02	8.14E-02	6.91E+05	5.79E+06	4.41E+02
5.00E+02	8.16E-02	6.94E+05	5.80E+06	4.40E+02
5.00E+02	8.19E-02	6.97E+05	5.81E+06	4.42E+02
5.00E+02	8.22E-02	7.00E+05	5.82E+06	4.43E+02

5.00E+02	8.24E-02	7.05E+05	5.83E+06	4.48E+02
5.00E+02	8.27E-02	7.07E+05	5.85E+06	4.47E+02
5.00E+02	8.30E-02	7.11E+05	5.86E+06	4.49E+02
5.00E+02	8.33E-02	7.15E+05	5.87E+06	4.53E+02
5.00E+02	8.35E-02	7.18E+05	5.88E+06	4.52E+02
5.00E+02	8.38E-02	7.20E+05	5.90E+06	4.51E+02
5.00E+02	8.41E-02	7.25E+05	5.91E+06	4.57E+02
5.00E+02	8.44E-02	7.30E+05	5.92E+06	4.60E+02
5.00E+02	8.46E-02	7.30E+05	5.93E+06	4.55E+02
5.00E+02	8.49E-02	7.34E+05	5.94E+06	4.60E+02
5.00E+02	8.52E-02	7.39E+05	5.96E+06	4.63E+02
5.00E+02	8.55E-02	7.41E+05	5.97E+06	4.62E+02
5.00E+02	8.57E-02	7.43E+05	5.98E+06	4.62E+02
5.00E+02	8.60E-02	7.48E+05	5.99E+06	4.66E+02
5.00E+02	8.63E-02	7.49E+05	6.00E+06	4.62E+02
5.00E+02	8.66E-02	7.53E+05	6.01E+06	4.65E+02
5.00E+02	8.69E-02	7.58E+05	6.02E+06	4.69E+02
5.00E+02	8.71E-02	7.59E+05	6.04E+06	4.67E+02
5.00E+02	8.74E-02	7.64E+05	6.05E+06	4.70E+02
5.00E+02	8.77E-02	7.66E+05	6.06E+06	4.70E+02
5.00E+02	8.80E-02	7.71E+05	6.07E+06	4.74E+02
5.00E+02	8.82E-02	7.72E+05	6.08E+06	4.70E+02
5.00E+02	8.85E-02	7.77E+05	6.09E+06	4.75E+02
5.00E+02	8.88E-02	7.81E+05	6.10E+06	4.78E+02
5.00E+02	8.91E-02	7.82E+05	6.11E+06	4.74E+02
5.00E+02	8.94E-02	7.84E+05	6.13E+06	4.73E+02
5.00E+02	8.96E-02	7.90E+05	6.14E+06	4.79E+02
5.00E+02	8.99E-02	7.93E+05	6.15E+06	4.80E+02
5.00E+02	9.02E-02	7.94E+05	6.16E+06	4.77E+02
5.00E+02	9.05E-02	7.99E+05	6.17E+06	4.82E+02
5.00E+02	9.08E-02	8.02E+05	6.18E+06	4.81E+02
5.00E+02	9.11E-02	8.05E+05	6.19E+06	4.82E+02
5.00E+02	9.13E-02	8.08E+05	6.20E+06	4.83E+02
5.00E+02	9.16E-02	8.12E+05	6.21E+06	4.86E+02
5.00E+02	9.19E-02	8.15E+05	6.22E+06	4.87E+02
5.00E+02	9.22E-02	8.18E+05	6.23E+06	4.87E+02
5.00E+02	9.25E-02	8.22E+05	6.24E+06	4.90E+02
5.00E+02	9.28E-02	8.25E+05	6.25E+06	4.91E+02
5.00E+02	9.30E-02	8.29E+05	6.26E+06	4.92E+02
5.00E+02	9.33E-02	8.30E+05	6.27E+06	4.90E+02
5.00E+02	9.36E-02	8.36E+05	6.28E+06	4.95E+02
5.00E+02	9.39E-02	8.38E+05	6.29E+06	4.94E+02

5.00E+02	9.42E-02	8.41E+05	6.30E+06	4.94E+02
5.00E+02	9.45E-02	8.46E+05	6.31E+06	4.98E+02
5.00E+02	9.48E-02	8.49E+05	6.32E+06	4.99E+02
5.00E+02	9.51E-02	8.52E+05	6.33E+06	5.00E+02
5.00E+02	9.53E-02	8.54E+05	6.34E+06	4.98E+02
5.00E+02	9.56E-02	8.57E+05	6.35E+06	4.99E+02
5.00E+02	9.59E-02	8.61E+05	6.36E+06	5.02E+02
5.00E+02	9.62E-02	8.64E+05	6.37E+06	5.02E+02
5.00E+02	9.65E-02	8.68E+05	6.38E+06	5.05E+02
5.00E+02	9.68E-02	8.73E+05	6.39E+06	5.09E+02
5.00E+02	9.71E-02	8.77E+05	6.40E+06	5.10E+02
5.00E+02	9.74E-02	8.78E+05	6.41E+06	5.08E+02
5.00E+02	9.77E-02	8.84E+05	6.42E+06	5.13E+02
5.00E+02	9.79E-02	8.89E+05	6.43E+06	5.18E+02
5.00E+02	9.82E-02	8.90E+05	6.44E+06	5.15E+02
5.00E+02	9.85E-02	8.93E+05	6.45E+06	5.16E+02
5.00E+02	9.88E-02	8.99E+05	6.46E+06	5.22E+02
5.00E+02	9.91E-02	9.03E+05	6.47E+06	5.25E+02
5.00E+02	9.94E-02	9.06E+05	6.48E+06	5.25E+02
5.00E+02	9.97E-02	9.11E+05	6.48E+06	5.28E+02
5.00E+02	1.00E-01	9.15E+05	6.49E+06	5.31E+02
5.00E+02	1.00E-01	9.18E+05	6.50E+06	5.31E+02
5.00E+02	1.01E-01	9.21E+05	6.51E+06	5.32E+02
5.00E+02	1.01E-01	9.26E+05	6.52E+06	5.37E+02
5.00E+02	1.01E-01	9.32E+05	6.53E+06	5.43E+02
5.00E+02	1.01E-01	9.33E+05	6.54E+06	5.40E+02
5.00E+02	1.02E-01	9.36E+05	6.55E+06	5.40E+02
5.00E+02	1.02E-01	9.41E+05	6.55E+06	5.44E+02
5.00E+02	1.02E-01	9.47E+05	6.56E+06	5.50E+02
5.00E+02	1.03E-01	9.47E+05	6.57E+06	5.46E+02
5.00E+02	1.03E-01	9.54E+05	6.58E+06	5.54E+02
5.00E+02	1.03E-01	9.60E+05	6.59E+06	5.59E+02
5.00E+02	1.04E-01	9.60E+05	6.60E+06	5.54E+02
5.00E+02	1.04E-01	9.66E+05	6.61E+06	5.60E+02
5.00E+02	1.04E-01	9.71E+05	6.61E+06	5.65E+02
5.00E+02	1.04E-01	9.73E+05	6.62E+06	5.63E+02
5.00E+02	1.05E-01	9.77E+05	6.63E+06	5.66E+02
5.00E+02	1.05E-01	9.82E+05	6.64E+06	5.70E+02
5.00E+02	1.05E-01	9.84E+05	6.65E+06	5.69E+02
5.00E+02	1.06E-01	9.92E+05	6.65E+06	5.78E+02
5.00E+02	1.06E-01	9.95E+05	6.66E+06	5.78E+02
5.00E+02	1.06E-01	9.98E+05	6.67E+06	5.80E+02

5.00E+02	1.07E-01	1.00E+06	6.68E+06	5.82E+02
5.00E+02	1.07E-01	1.01E+06	6.69E+06	5.91E+02
5.00E+02	1.07E-01	1.01E+06	6.69E+06	5.92E+02
5.00E+02	1.07E-01	1.01E+06	6.70E+06	5.89E+02
5.00E+02	1.08E-01	1.02E+06	6.71E+06	6.00E+02
5.00E+02	1.08E-01	1.03E+06	6.72E+06	6.01E+02
5.00E+02	1.08E-01	1.03E+06	6.72E+06	6.03E+02
5.00E+02	1.09E-01	1.03E+06	6.73E+06	6.07E+02
5.00E+02	1.09E-01	1.04E+06	6.74E+06	6.17E+02
5.00E+02	1.09E-01	1.04E+06	6.75E+06	6.14E+02
5.00E+02	1.10E-01	1.05E+06	6.75E+06	6.15E+02
5.00E+02	1.10E-01	1.06E+06	6.76E+06	6.30E+02
5.00E+02	1.10E-01	1.06E+06	6.77E+06	6.34E+02
5.00E+02	1.10E-01	1.06E+06	6.77E+06	6.27E+02
5.00E+02	1.11E-01	1.07E+06	6.78E+06	6.38E+02
5.00E+02	1.11E-01	1.08E+06	6.79E+06	6.49E+02
5.00E+02	1.11E-01	1.08E+06	6.80E+06	6.43E+02
5.00E+02	1.12E-01	1.09E+06	6.80E+06	6.53E+02
5.00E+02	1.12E-01	1.09E+06	6.81E+06	6.64E+02
5.00E+02	1.12E-01	1.09E+06	6.82E+06	6.58E+02
5.00E+02	1.13E-01	1.10E+06	6.82E+06	6.62E+02
5.00E+02	1.13E-01	1.11E+06	6.83E+06	6.74E+02
5.00E+02	1.13E-01	1.11E+06	6.84E+06	6.75E+02
5.00E+02	1.13E-01	1.12E+06	6.84E+06	6.82E+02
5.00E+02	1.14E-01	1.12E+06	6.85E+06	6.87E+02
5.00E+02	1.14E-01	1.13E+06	6.86E+06	6.91E+02
5.00E+02	1.14E-01	1.13E+06	6.86E+06	6.95E+02
5.00E+02	1.15E-01	1.14E+06	6.87E+06	6.97E+02
5.00E+02	1.15E-01	1.14E+06	6.88E+06	7.07E+02
5.00E+02	1.15E-01	1.15E+06	6.88E+06	7.13E+02
5.00E+02	1.16E-01	1.15E+06	6.89E+06	7.13E+02
5.00E+02	1.16E-01	1.16E+06	6.90E+06	7.18E+02
5.00E+02	1.16E-01	1.17E+06	6.90E+06	7.30E+02
5.00E+02	1.17E-01	1.17E+06	6.91E+06	7.29E+02
5.00E+02	1.17E-01	1.18E+06	6.92E+06	7.35E+02
5.00E+02	1.17E-01	1.18E+06	6.92E+06	7.44E+02
5.00E+02	1.17E-01	1.19E+06	6.93E+06	7.48E+02
5.00E+02	1.18E-01	1.19E+06	6.94E+06	7.51E+02
5.00E+02	1.18E-01	1.20E+06	6.94E+06	7.54E+02
5.00E+02	1.18E-01	1.20E+06	6.95E+06	7.60E+02
5.00E+02	1.19E-01	1.21E+06	6.95E+06	7.64E+02
5.00E+02	1.19E-01	1.21E+06	6.96E+06	7.70E+02

5.00E+02	1.19E-01	1.22E+06	6.97E+06	7.77E+02
5.00E+02	1.20E-01	1.22E+06	6.97E+06	7.80E+02
5.00E+02	1.20E-01	1.23E+06	6.98E+06	7.87E+02
5.00E+02	1.20E-01	1.24E+06	6.98E+06	7.91E+02
5.00E+02	1.21E-01	1.24E+06	6.99E+06	8.00E+02
5.00E+02	1.21E-01	1.25E+06	7.00E+06	7.99E+02
5.00E+02	1.21E-01	1.25E+06	7.00E+06	8.04E+02
5.00E+02	1.21E-01	1.26E+06	7.01E+06	8.08E+02
5.00E+02	1.22E-01	1.26E+06	7.01E+06	8.15E+02
5.00E+02	1.22E-01	1.27E+06	7.02E+06	8.17E+02
5.00E+02	1.22E-01	1.27E+06	7.02E+06	8.24E+02
5.00E+02	1.23E-01	1.28E+06	7.03E+06	8.33E+02
5.00E+02	1.23E-01	1.28E+06	7.04E+06	8.36E+02
5.00E+02	1.23E-01	1.29E+06	7.04E+06	8.39E+02
5.00E+02	1.24E-01	1.30E+06	7.05E+06	8.48E+02
5.00E+02	1.24E-01	1.30E+06	7.05E+06	8.51E+02
5.00E+02	1.24E-01	1.30E+06	7.06E+06	8.50E+02
5.00E+02	1.25E-01	1.31E+06	7.06E+06	8.56E+02
5.00E+02	1.25E-01	1.32E+06	7.07E+06	8.65E+02
5.00E+02	1.25E-01	1.32E+06	7.08E+06	8.68E+02
5.00E+02	1.26E-01	1.32E+06	7.08E+06	8.70E+02
5.00E+02	1.26E-01	1.33E+06	7.09E+06	8.80E+02
5.00E+02	1.26E-01	1.33E+06	7.09E+06	8.79E+02
5.00E+02	1.27E-01	1.34E+06	7.10E+06	8.83E+02
5.00E+02	1.27E-01	1.35E+06	7.10E+06	8.89E+02
5.00E+02	1.27E-01	1.35E+06	7.11E+06	8.99E+02
5.00E+02	1.27E-01	1.36E+06	7.11E+06	8.99E+02
5.00E+02	1.28E-01	1.36E+06	7.12E+06	9.00E+02
5.00E+02	1.28E-01	1.37E+06	7.12E+06	9.09E+02
5.00E+02	1.28E-01	1.37E+06	7.13E+06	9.17E+02
5.00E+02	1.29E-01	1.37E+06	7.13E+06	9.12E+02
5.00E+02	1.29E-01	1.38E+06	7.14E+06	9.22E+02
5.00E+02	1.29E-01	1.39E+06	7.14E+06	9.27E+02
5.00E+02	1.30E-01	1.39E+06	7.15E+06	9.30E+02
5.00E+02	1.30E-01	1.40E+06	7.15E+06	9.32E+02
5.00E+02	1.30E-01	1.40E+06	7.16E+06	9.42E+02
5.00E+02	1.31E-01	1.41E+06	7.17E+06	9.41E+02
5.00E+02	1.31E-01	1.41E+06	7.17E+06	9.44E+02
5.00E+02	1.31E-01	1.42E+06	7.18E+06	9.57E+02
5.00E+02	1.32E-01	1.43E+06	7.18E+06	9.61E+02
5.00E+02	1.32E-01	1.43E+06	7.19E+06	9.56E+02
5.00E+02	1.32E-01	1.44E+06	7.19E+06	9.70E+02

5.00E+02	1.33E-01	1.44E+06	7.20E+06	9.70E+02
5.00E+02	1.33E-01	1.44E+06	7.20E+06	9.71E+02
5.00E+02	1.33E-01	1.45E+06	7.21E+06	9.77E+02
5.00E+02	1.33E-01	1.45E+06	7.21E+06	9.82E+02
5.00E+02	1.34E-01	1.46E+06	7.22E+06	9.86E+02
5.00E+02	1.34E-01	1.46E+06	7.22E+06	9.90E+02
5.00E+02	1.34E-01	1.47E+06	7.23E+06	9.93E+02
5.00E+02	1.35E-01	1.47E+06	7.23E+06	9.99E+02
5.00E+02	1.35E-01	1.48E+06	7.24E+06	1.00E+03
5.00E+02	1.35E-01	1.48E+06	7.24E+06	1.00E+03
5.00E+02	1.36E-01	1.49E+06	7.25E+06	1.02E+03
5.00E+02	1.36E-01	1.50E+06	7.25E+06	1.02E+03
5.00E+02	1.36E-01	1.50E+06	7.26E+06	1.01E+03
5.00E+02	1.37E-01	1.51E+06	7.26E+06	1.03E+03
5.00E+02	1.37E-01	1.51E+06	7.27E+06	1.03E+03
5.00E+02	1.37E-01	1.51E+06	7.27E+06	1.03E+03
5.00E+02	1.38E-01	1.52E+06	7.28E+06	1.04E+03
5.00E+02	1.38E-01	1.52E+06	7.28E+06	1.04E+03
5.00E+02	1.38E-01	1.53E+06	7.29E+06	1.05E+03
5.00E+02	1.39E-01	1.54E+06	7.29E+06	1.05E+03
5.00E+02	1.39E-01	1.54E+06	7.30E+06	1.04E+03
5.00E+02	1.39E-01	1.55E+06	7.30E+06	1.06E+03
5.00E+02	1.40E-01	1.55E+06	7.30E+06	1.06E+03
5.00E+02	1.40E-01	1.55E+06	7.31E+06	1.06E+03
5.00E+02	1.40E-01	1.56E+06	7.31E+06	1.07E+03
5.00E+02	1.41E-01	1.56E+06	7.32E+06	1.07E+03
5.00E+02	1.41E-01	1.57E+06	7.32E+06	1.07E+03
5.00E+02	1.41E-01	1.58E+06	7.33E+06	1.08E+03
5.00E+02	1.42E-01	1.58E+06	7.33E+06	1.08E+03
5.00E+02	1.42E-01	1.58E+06	7.34E+06	1.08E+03
5.00E+02	1.42E-01	1.59E+06	7.34E+06	1.09E+03
5.00E+02	1.43E-01	1.59E+06	7.35E+06	1.09E+03
5.00E+02	1.43E-01	1.60E+06	7.35E+06	1.10E+03
5.00E+02	1.43E-01	1.60E+06	7.36E+06	1.10E+03
5.00E+02	1.43E-01	1.61E+06	7.36E+06	1.10E+03
5.00E+02	1.44E-01	1.62E+06	7.37E+06	1.11E+03
5.00E+02	1.44E-01	1.62E+06	7.37E+06	1.12E+03
5.00E+02	1.44E-01	1.62E+06	7.38E+06	1.11E+03
5.00E+02	1.45E-01	1.63E+06	7.38E+06	1.12E+03
5.00E+02	1.45E-01	1.64E+06	7.39E+06	1.13E+03
5.00E+02	1.45E-01	1.64E+06	7.39E+06	1.13E+03
5.00E+02	1.46E-01	1.65E+06	7.40E+06	1.13E+03

5.00E+02	1.46E-01	1.65E+06	7.40E+06	1.14E+03
5.00E+02	1.46E-01	1.66E+06	7.41E+06	1.15E+03
5.00E+02	1.47E-01	1.66E+06	7.41E+06	1.14E+03
5.00E+02	1.47E-01	1.67E+06	7.42E+06	1.15E+03
5.00E+02	1.47E-01	1.67E+06	7.42E+06	1.15E+03
5.00E+02	1.48E-01	1.68E+06	7.43E+06	1.16E+03
5.00E+02	1.48E-01	1.68E+06	7.43E+06	1.16E+03
5.00E+02	1.48E-01	1.69E+06	7.44E+06	1.17E+03
5.00E+02	1.49E-01	1.69E+06	7.44E+06	1.17E+03
5.00E+02	1.49E-01	1.70E+06	7.45E+06	1.17E+03
5.00E+02	1.49E-01	1.71E+06	7.45E+06	1.18E+03
5.00E+02	1.50E-01	1.71E+06	7.46E+06	1.18E+03
5.00E+02	1.50E-01	1.71E+06	7.47E+06	1.18E+03
5.00E+02	1.50E-01	1.72E+06	7.47E+06	1.19E+03
5.00E+02	1.51E-01	1.73E+06	7.48E+06	1.20E+03
5.00E+02	1.51E-01	1.73E+06	7.48E+06	1.19E+03
5.00E+02	1.51E-01	1.73E+06	7.49E+06	1.20E+03
5.00E+02	1.52E-01	1.74E+06	7.49E+06	1.21E+03
5.00E+02	1.52E-01	1.75E+06	7.50E+06	1.22E+03
5.00E+02	1.52E-01	1.75E+06	7.50E+06	1.21E+03
5.00E+02	1.53E-01	1.76E+06	7.51E+06	1.22E+03
5.00E+02	1.53E-01	1.77E+06	7.51E+06	1.23E+03
5.00E+02	1.53E-01	1.77E+06	7.52E+06	1.23E+03
5.00E+02	1.54E-01	1.77E+06	7.52E+06	1.23E+03
5.00E+02	1.54E-01	1.78E+06	7.53E+06	1.24E+03
5.00E+02	1.54E-01	1.78E+06	7.53E+06	1.24E+03
5.00E+02	1.55E-01	1.79E+06	7.54E+06	1.25E+03
5.00E+02	1.55E-01	1.80E+06	7.55E+06	1.26E+03
5.00E+02	1.55E-01	1.79E+06	7.55E+06	1.24E+03
5.00E+02	1.56E-01	1.81E+06	7.56E+06	1.26E+03
5.00E+02	1.56E-01	1.81E+06	7.56E+06	1.27E+03
5.00E+02	1.56E-01	1.82E+06	7.57E+06	1.27E+03
5.00E+02	1.57E-01	1.82E+06	7.57E+06	1.26E+03
5.00E+02	1.57E-01	1.83E+06	7.58E+06	1.28E+03
5.00E+02	1.57E-01	1.83E+06	7.58E+06	1.28E+03
5.00E+02	1.58E-01	1.83E+06	7.59E+06	1.27E+03
5.00E+02	1.58E-01	1.84E+06	7.60E+06	1.28E+03
5.00E+02	1.58E-01	1.85E+06	7.60E+06	1.29E+03
5.00E+02	1.59E-01	1.85E+06	7.61E+06	1.29E+03
5.00E+02	1.59E-01	1.86E+06	7.61E+06	1.30E+03
5.00E+02	1.59E-01	1.86E+06	7.62E+06	1.30E+03
5.00E+02	1.60E-01	1.87E+06	7.63E+06	1.31E+03

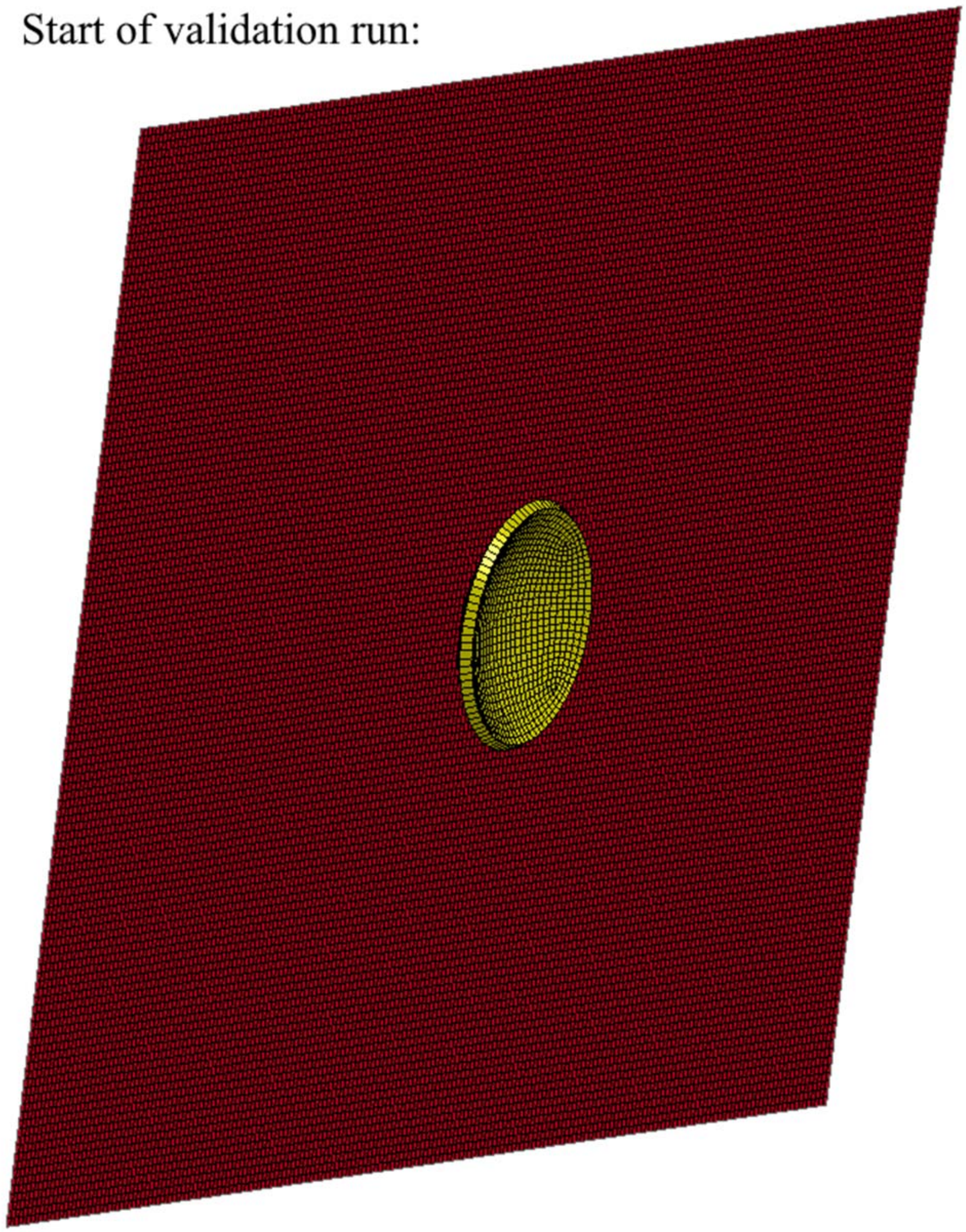
5.00E+02	1.60E-01	1.88E+06	7.63E+06	1.31E+03
5.00E+02	1.60E-01	1.88E+06	7.64E+06	1.31E+03
5.00E+02	1.61E-01	1.88E+06	7.64E+06	1.31E+03
5.00E+02	1.61E-01	1.89E+06	7.65E+06	1.32E+03
5.00E+02	1.61E-01	1.89E+06	7.66E+06	1.32E+03
5.00E+02	1.62E-01	1.90E+06	7.66E+06	1.33E+03
5.00E+02	1.62E-01	1.91E+06	7.67E+06	1.33E+03
5.00E+02	1.62E-01	1.92E+06	7.67E+06	1.34E+03
5.00E+02	1.63E-01	1.91E+06	7.68E+06	1.33E+03
5.00E+02	1.63E-01	1.92E+06	7.69E+06	1.34E+03
5.00E+02	1.63E-01	1.93E+06	7.69E+06	1.35E+03
5.00E+02	1.64E-01	1.94E+06	7.70E+06	1.36E+03
5.00E+02	1.64E-01	1.94E+06	7.70E+06	1.35E+03
5.00E+02	1.64E-01	1.95E+06	7.71E+06	1.36E+03
5.00E+02	1.65E-01	1.95E+06	7.72E+06	1.36E+03
5.00E+02	1.65E-01	1.96E+06	7.72E+06	1.38E+03
5.00E+02	1.65E-01	1.96E+06	7.73E+06	1.37E+03
5.00E+02	1.66E-01	1.97E+06	7.74E+06	1.37E+03
5.00E+02	1.66E-01	1.97E+06	7.74E+06	1.37E+03
5.00E+02	1.66E-01	1.98E+06	7.75E+06	1.39E+03
5.00E+02	1.67E-01	1.99E+06	7.76E+06	1.39E+03
5.00E+02	1.67E-01	1.99E+06	7.76E+06	1.39E+03
5.00E+02	1.67E-01	2.00E+06	7.77E+06	1.40E+03
5.00E+02	1.68E-01	2.01E+06	7.78E+06	1.41E+03
5.00E+02	1.68E-01	2.01E+06	7.78E+06	1.41E+03
5.00E+02	1.68E-01	2.01E+06	7.79E+06	1.40E+03
5.00E+02	1.69E-01	2.02E+06	7.80E+06	1.42E+03
5.00E+02	1.69E-01	2.03E+06	7.80E+06	1.42E+03
5.00E+02	1.69E-01	2.03E+06	7.81E+06	1.42E+03
5.00E+02	1.70E-01	2.04E+06	7.82E+06	1.43E+03
5.00E+02	1.70E-01	2.05E+06	7.83E+06	1.43E+03
5.00E+02	1.70E-01	2.05E+06	7.83E+06	1.43E+03
5.00E+02	1.71E-01	2.06E+06	7.84E+06	1.45E+03
5.00E+02	1.71E-01	2.07E+06	7.85E+06	1.45E+03
5.00E+02	1.71E-01	2.07E+06	7.85E+06	1.44E+03
5.00E+02	1.72E-01	2.08E+06	7.86E+06	1.45E+03
5.00E+02	1.72E-01	2.08E+06	7.87E+06	1.46E+03
5.00E+02	1.72E-01	2.09E+06	7.88E+06	1.46E+03
5.00E+02	1.73E-01	2.09E+06	7.88E+06	1.46E+03
5.00E+02	1.73E-01	2.10E+06	7.89E+06	1.48E+03
5.00E+02	1.73E-01	2.11E+06	7.90E+06	1.48E+03
5.00E+02	1.74E-01	2.11E+06	7.90E+06	1.48E+03

5.00E+02	1.74E-01	2.12E+06	7.91E+06	1.48E+03
5.00E+02	1.74E-01	2.13E+06	7.92E+06	1.49E+03
5.00E+02	1.75E-01	2.13E+06	7.93E+06	1.50E+03
5.00E+02	1.75E-01	2.14E+06	7.94E+06	1.50E+03
5.00E+02	1.75E-01	2.15E+06	7.94E+06	1.50E+03
5.00E+02	1.76E-01	2.15E+06	7.95E+06	1.51E+03
5.00E+02	1.76E-01	2.16E+06	7.96E+06	1.51E+03
5.00E+02	1.76E-01	2.16E+06	7.97E+06	1.51E+03
5.00E+02	1.77E-01	2.17E+06	7.97E+06	1.52E+03
5.00E+02	1.77E-01	2.18E+06	7.98E+06	1.53E+03
5.00E+02	1.77E-01	2.18E+06	7.99E+06	1.53E+03
5.00E+02	1.78E-01	2.19E+06	8.00E+06	1.54E+03
5.00E+02	1.78E-01	2.19E+06	8.01E+06	1.54E+03
5.00E+02	1.78E-01	2.20E+06	8.01E+06	1.55E+03
5.00E+02	1.79E-01	2.21E+06	8.02E+06	1.55E+03
5.00E+02	1.79E-01	2.21E+06	8.03E+06	1.55E+03
5.00E+02	1.79E-01	2.22E+06	8.04E+06	1.56E+03
5.00E+02	1.80E-01	2.23E+06	8.05E+06	1.56E+03
5.00E+02	1.80E-01	2.23E+06	8.06E+06	1.56E+03
5.00E+02	1.80E-01	2.24E+06	8.06E+06	1.57E+03
5.00E+02	1.81E-01	2.25E+06	8.07E+06	1.58E+03
5.00E+02	1.81E-01	2.25E+06	8.08E+06	1.57E+03
5.00E+02	1.81E-01	2.26E+06	8.09E+06	1.58E+03
5.00E+02	1.82E-01	2.26E+06	8.10E+06	1.59E+03
5.00E+02	1.82E-01	2.27E+06	8.11E+06	1.60E+03
5.00E+02	1.82E-01	2.28E+06	8.11E+06	1.60E+03
5.00E+02	1.83E-01	2.28E+06	8.12E+06	1.59E+03
5.00E+02	1.83E-01	2.29E+06	8.13E+06	1.61E+03
5.00E+02	1.83E-01	2.30E+06	8.14E+06	1.61E+03
5.00E+02	1.84E-01	2.30E+06	8.15E+06	1.61E+03
5.00E+02	1.84E-01	2.31E+06	8.16E+06	1.62E+03
5.00E+02	1.84E-01	2.32E+06	8.17E+06	1.62E+03
5.00E+02	1.85E-01	2.32E+06	8.18E+06	1.63E+03
5.00E+02	1.85E-01	2.33E+06	8.18E+06	1.63E+03
5.00E+02	1.85E-01	2.34E+06	8.19E+06	1.63E+03
5.00E+02	1.86E-01	2.34E+06	8.20E+06	1.64E+03
5.00E+02	1.86E-01	2.35E+06	8.21E+06	1.65E+03
5.00E+02	1.86E-01	2.35E+06	8.22E+06	1.64E+03
5.00E+02	1.87E-01	2.36E+06	8.23E+06	1.65E+03
5.00E+02	1.87E-01	2.37E+06	8.24E+06	1.66E+03
5.00E+02	1.87E-01	2.38E+06	8.25E+06	1.67E+03
5.00E+02	1.88E-01	2.38E+06	8.26E+06	1.66E+03

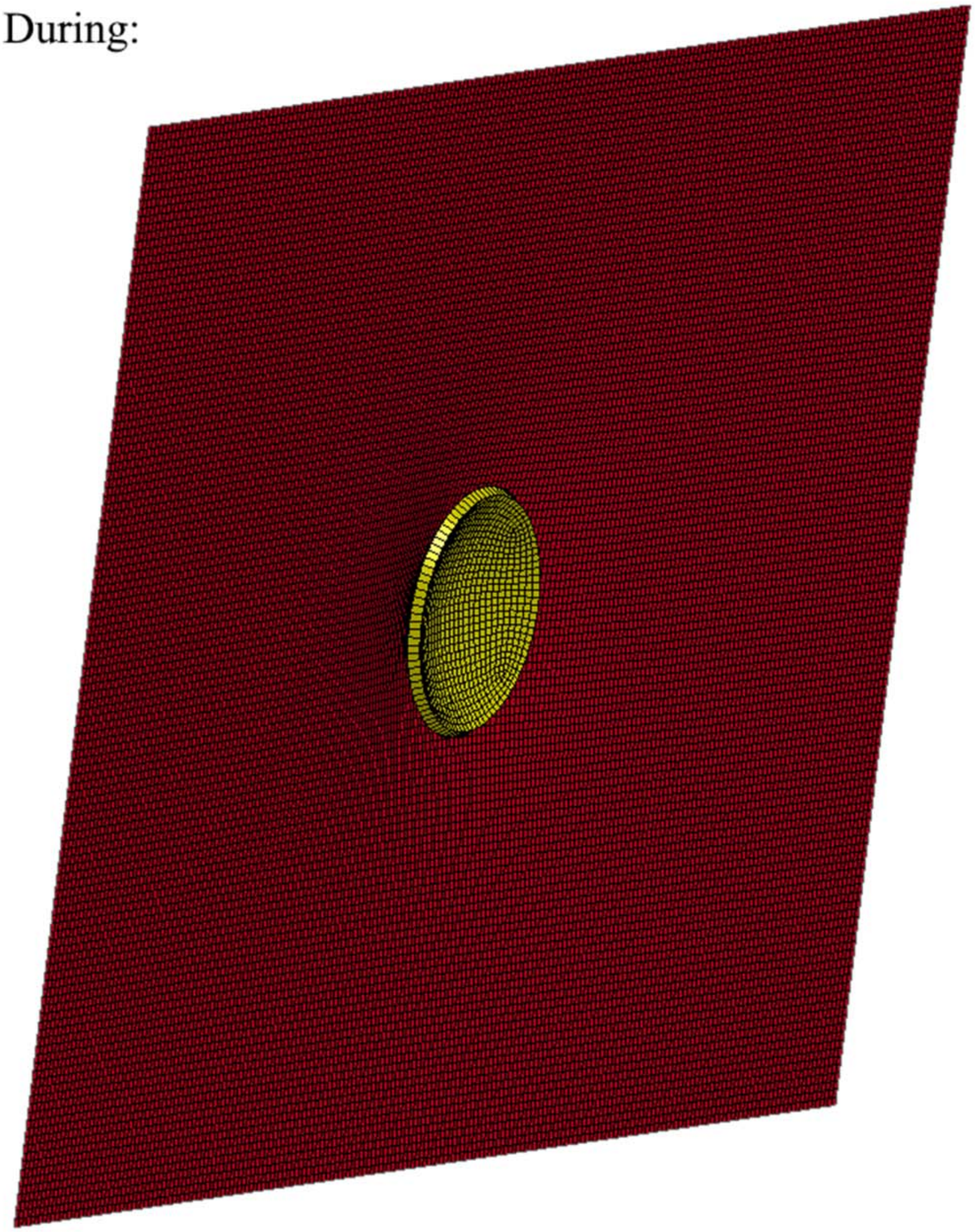
5.00E+02	1.88E-01	2.39E+06	8.27E+06	1.66E+03
5.00E+02	1.88E-01	2.40E+06	8.28E+06	1.68E+03
5.00E+02	1.89E-01	2.41E+06	8.29E+06	1.69E+03
5.00E+02	1.89E-01	2.41E+06	8.29E+06	1.68E+03
5.00E+02	1.89E-01	2.41E+06	8.30E+06	1.68E+03
5.00E+02	1.90E-01	2.42E+06	8.31E+06	1.69E+03
5.00E+02	1.90E-01	2.43E+06	8.32E+06	1.70E+03
5.00E+02	1.90E-01	2.43E+06	8.33E+06	1.70E+03
5.00E+02	1.91E-01	2.44E+06	8.34E+06	1.70E+03
5.00E+02	1.91E-01	2.45E+06	8.35E+06	1.71E+03
5.00E+02	1.91E-01	2.46E+06	8.36E+06	1.71E+03
5.00E+02	1.92E-01	2.46E+06	8.37E+06	1.71E+03
5.00E+02	1.92E-01	2.47E+06	8.38E+06	1.72E+03
5.00E+02	1.92E-01	2.48E+06	8.39E+06	1.74E+03
5.00E+02	1.93E-01	2.49E+06	8.40E+06	1.73E+03
5.00E+02	1.93E-01	2.49E+06	8.41E+06	1.73E+03
5.00E+02	1.93E-01	2.50E+06	8.42E+06	1.75E+03
5.00E+02	1.94E-01	2.51E+06	8.43E+06	1.75E+03
5.00E+02	1.94E-01	2.51E+06	8.44E+06	1.74E+03
5.00E+02	1.94E-01	2.52E+06	8.45E+06	1.75E+03
5.00E+02	1.95E-01	2.52E+06	8.46E+06	1.75E+03
5.00E+02	1.95E-01	2.53E+06	8.47E+06	1.75E+03
5.00E+02	1.95E-01	2.54E+06	8.48E+06	1.76E+03
5.00E+02	1.96E-01	2.55E+06	8.49E+06	1.77E+03
5.00E+02	1.96E-01	2.55E+06	8.50E+06	1.77E+03
5.00E+02	1.96E-01	2.55E+06	8.51E+06	1.76E+03
5.00E+02	1.97E-01	2.56E+06	8.52E+06	1.77E+03
5.00E+02	1.97E-01	2.57E+06	8.53E+06	1.77E+03
5.00E+02	1.97E-01	2.57E+06	8.54E+06	1.77E+03
5.00E+02	1.98E-01	2.58E+06	8.55E+06	1.77E+03
5.00E+02	1.98E-01	2.59E+06	8.56E+06	1.79E+03
5.00E+02	1.98E-01	2.60E+06	8.57E+06	1.79E+03
5.00E+02	1.99E-01	2.60E+06	8.58E+06	1.78E+03
5.00E+02	1.99E-01	2.60E+06	8.59E+06	1.79E+03
5.00E+02	1.99E-01	2.61E+06	8.60E+06	1.79E+03
5.00E+02	2.00E-01	2.62E+06	8.61E+06	1.80E+03
5.00E+02	2.00E-01	2.63E+06	8.62E+06	1.80E+03
5.00E+02	2.00E-01	2.63E+06	8.63E+06	1.80E+03
5.00E+02	2.01E-01	2.63E+06	8.64E+06	1.80E+03
5.00E+02	2.01E-01	2.64E+06	8.65E+06	1.80E+03
5.00E+02	2.01E-01	2.65E+06	8.66E+06	1.81E+03
5.00E+02	2.02E-01	2.65E+06	8.67E+06	1.80E+03

5.00E+02	2.02E-01	2.66E+06	8.68E+06	1.81E+03
5.00E+02	2.02E-01	2.66E+06	8.70E+06	1.81E+03
5.00E+02	2.03E-01	2.67E+06	8.71E+06	1.81E+03
5.00E+02	2.03E-01	2.68E+06	8.72E+06	1.81E+03
5.00E+02	2.03E-01	2.68E+06	8.73E+06	1.81E+03
5.00E+02	2.04E-01	2.69E+06	8.74E+06	1.81E+03
5.00E+02	2.04E-01	2.70E+06	8.75E+06	1.82E+03
5.00E+02	2.04E-01	2.70E+06	8.76E+06	1.81E+03
5.00E+02	2.05E-01	2.70E+06	8.77E+06	1.82E+03
5.00E+02	2.05E-01	2.71E+06	8.78E+06	1.82E+03
5.00E+02	2.05E-01	2.72E+06	8.79E+06	1.82E+03
5.00E+02	2.06E-01	2.72E+06	8.80E+06	1.82E+03
5.00E+02	2.06E-01	2.73E+06	8.81E+06	1.82E+03
5.00E+02	2.06E-01	2.73E+06	8.82E+06	1.82E+03
5.00E+02	2.07E-01	2.74E+06	8.83E+06	1.83E+03
5.00E+02	2.07E-01	2.75E+06	8.84E+06	1.83E+03
5.00E+02	2.07E-01	2.75E+06	8.85E+06	1.82E+03
5.00E+02	2.08E-01	2.76E+06	8.86E+06	1.84E+03
5.00E+02	2.08E-01	2.76E+06	8.87E+06	1.83E+03
5.00E+02	2.08E-01	2.77E+06	8.89E+06	1.83E+03
5.00E+02	2.09E-01	2.78E+06	8.90E+06	1.83E+03
5.00E+02	2.09E-01	2.78E+06	8.91E+06	1.83E+03
5.00E+02	2.09E-01	2.78E+06	8.92E+06	1.83E+03
5.00E+02	2.10E-01	2.79E+06	8.93E+06	1.84E+03
5.00E+02	2.10E-01	2.80E+06	8.94E+06	1.85E+03
5.00E+02	2.10E-01	2.80E+06	8.95E+06	1.83E+03
5.00E+02	2.11E-01	2.81E+06	8.96E+06	1.84E+03
5.00E+02	2.11E-01	2.82E+06	8.97E+06	1.85E+03
5.00E+02	2.11E-01	2.82E+06	8.98E+06	1.84E+03
5.00E+02	2.12E-01	2.83E+06	8.99E+06	1.85E+03
5.00E+02	2.12E-01	2.83E+06	9.00E+06	1.85E+03
5.00E+02	2.12E-01	2.84E+06	9.01E+06	1.85E+03
5.00E+02	2.13E-01	2.85E+06	9.02E+06	1.85E+03
5.00E+02	2.13E-01	2.85E+06	9.03E+06	1.85E+03
5.00E+02	2.13E-01	2.86E+06	9.04E+06	1.86E+03
5.00E+02	2.14E-01	2.87E+06	9.05E+06	1.86E+03
5.00E+02	2.14E-01	2.87E+06	9.06E+06	1.85E+03
5.00E+02	2.14E-01	2.88E+06	9.07E+06	1.86E+03
5.00E+02	2.15E-01	2.88E+06	9.08E+06	1.86E+03
5.00E+02	2.15E-01	2.89E+06	9.09E+06	1.86E+03
5.00E+02	2.15E-01	2.89E+06	9.10E+06	1.86E+03
5.00E+02	2.16E-01	2.90E+06	9.11E+06	1.87E+03

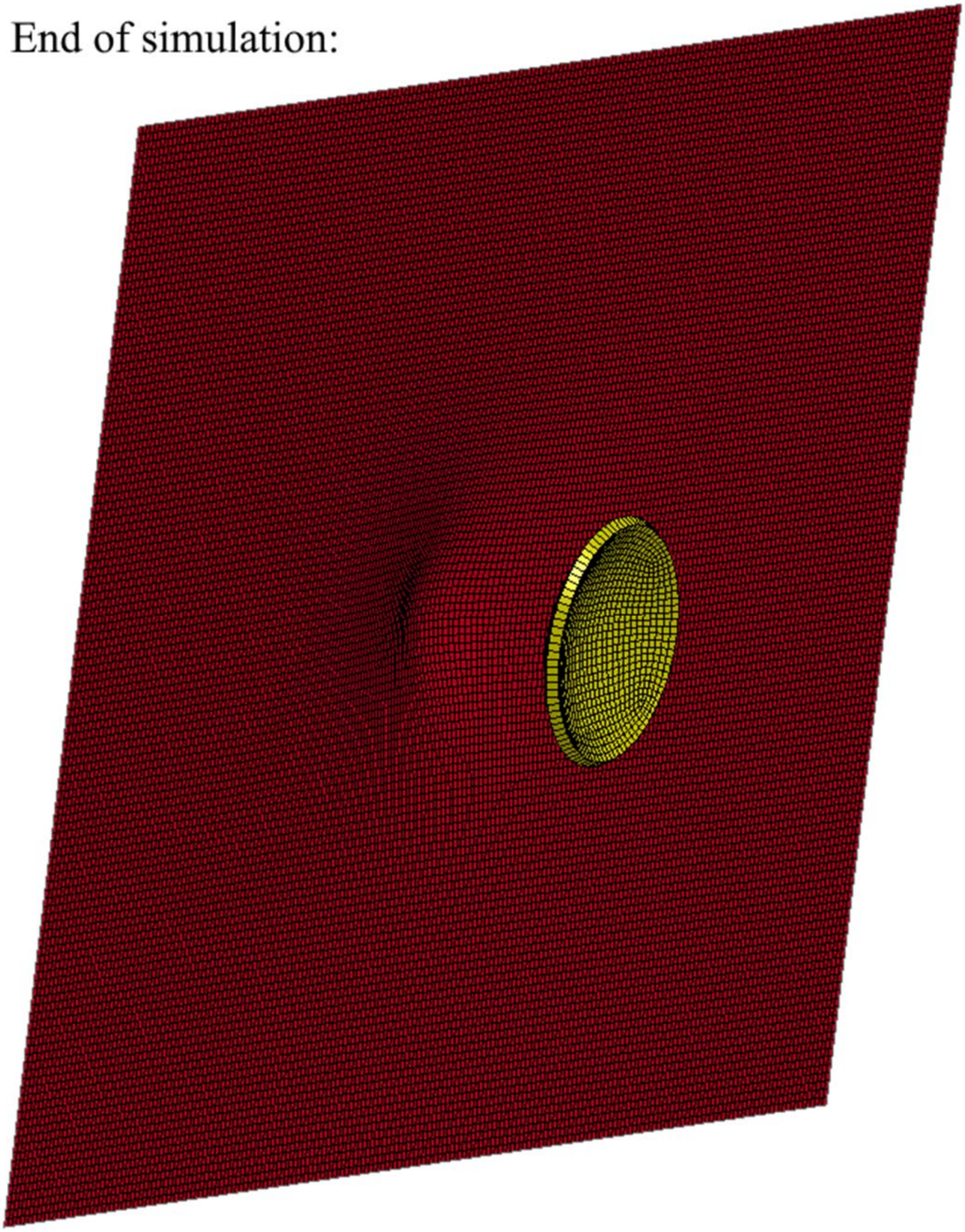
Appendix C **4.091 m/s simulated impact validation run**



During:



End of simulation:



Appendix D **4.091 m/s simulated impact validation results**

Disp.	Accel.	Stiffness	Mass	FEA Contact Force	Calculated Mass	Calculated Force
m	m/s^2	N/m	kg	N	kg	N
1.79E-04	0.00E+00	-8.20E+03	0.00E+00	1.41E+04	-	-
5.04E-04	-6.04E-15	-2.20E+04	-4.15E+18	2.51E+04	-	-
8.32E-04	1.51E-02	-3.43E+04	1.67E+06	2.51E+04	4.44E+03	3.83E+01
1.16E-03	3.55E-01	-4.53E+04	7.06E+04	2.50E+04	4.42E+02	1.04E+02
1.49E-03	2.94E-01	-5.48E+04	8.50E+04	2.49E+04	7.61E+02	1.43E+02
1.81E-03	-5.85E-01	-6.28E+04	-4.30E+04	2.50E+04	-	-
2.14E-03	2.12E-01	-6.95E+04	1.19E+05	2.51E+04	1.77E+03	2.27E+02
2.47E-03	-1.93E+00	-7.49E+04	-1.31E+04	2.51E+04	-	-
2.80E-03	2.51E+00	-7.89E+04	1.02E+04	2.53E+04	2.95E+02	5.19E+02
3.13E-03	9.61E-01	-8.17E+04	2.68E+04	2.55E+04	8.20E+02	5.33E+02
3.45E-03	3.43E-01	-8.32E+04	7.58E+04	2.57E+04	2.38E+03	5.31E+02
3.78E-03	-3.54E+00	-8.34E+04	-7.35E+03	2.57E+04	-	-
4.11E-03	-3.41E+00	-8.24E+04	-7.79E+03	2.62E+04	-	-
4.44E-03	1.07E+00	-8.02E+04	2.46E+04	2.60E+04	1.27E+03	1.00E+03
4.76E-03	1.68E+00	-7.68E+04	1.64E+04	2.71E+04	9.48E+02	1.22E+03
5.09E-03	4.65E-01	-7.23E+04	5.74E+04	2.63E+04	3.28E+03	1.16E+03
5.42E-03	1.01E+00	-6.67E+04	2.70E+04	2.69E+04	1.81E+03	1.47E+03
5.75E-03	3.03E+00	-5.99E+04	9.42E+03	2.82E+04	7.43E+02	1.91E+03
6.07E-03	4.27E+00	-5.21E+04	6.59E+03	2.78E+04	5.97E+02	2.23E+03
6.40E-03	3.95E+00	-4.32E+04	6.86E+03	2.68E+04	6.92E+02	2.46E+03
6.73E-03	3.58E+00	-3.34E+04	7.90E+03	2.81E+04	8.14E+02	2.69E+03
7.06E-03	3.30E+00	-2.25E+04	8.97E+03	2.95E+04	9.40E+02	2.95E+03
7.38E-03	7.69E-01	-1.07E+04	3.93E+04	3.01E+04	3.69E+03	2.76E+03
7.71E-03	1.46E-01	2.16E+03	2.12E+05	3.10E+04	1.73E+04	2.54E+03
8.04E-03	-1.02E+00	1.59E+04	-2.84E+04	2.92E+04	-	-
8.37E-03	-4.07E+00	3.06E+04	-7.16E+03	2.94E+04	-	-
8.69E-03	-6.37E+00	4.60E+04	-4.58E+03	2.96E+04	-	-
9.02E-03	-6.48E+00	6.24E+04	-4.70E+03	3.11E+04	-	-
9.35E-03	-6.97E+00	7.97E+04	-4.37E+03	3.12E+04	-	-
9.67E-03	-6.95E+00	9.78E+04	-4.47E+03	3.20E+04	-	-
1.00E-02	-9.62E+00	1.17E+05	-3.45E+03	3.44E+04	-	-
1.03E-02	-7.80E+00	1.36E+05	-4.45E+03	3.61E+04	-	-
1.06E-02	-5.48E+00	1.56E+05	-6.24E+03	3.59E+04	-	-
1.10E-02	-3.56E+00	1.78E+05	-9.25E+03	3.49E+04	-	-
1.13E-02	-1.32E+00	1.99E+05	-2.49E+04	3.52E+04	-	-
1.16E-02	-1.13E+00	2.22E+05	-2.95E+04	3.60E+04	-	-
1.20E-02	-2.63E+00	2.45E+05	-1.25E+04	3.58E+04	-	-
1.23E-02	-1.96E+00	2.69E+05	-1.66E+04	3.59E+04	-	-

1.26E-02	1.38E+00	2.94E+05	2.28E+04	3.52E+04	4.93E+03	1.05E+04
1.29E-02	1.94E+00	3.19E+05	1.69E+04	3.68E+04	3.79E+03	1.15E+04
1.33E-02	1.19E+00	3.45E+05	2.85E+04	3.84E+04	6.10E+03	1.18E+04
1.36E-02	2.46E+00	3.71E+05	1.36E+04	3.86E+04	3.31E+03	1.32E+04
1.39E-02	4.54E+00	3.98E+05	7.11E+03	3.78E+04	1.99E+03	1.46E+04
1.42E-02	3.15E+00	4.26E+05	1.01E+04	3.77E+04	2.85E+03	1.50E+04
1.46E-02	-2.32E-01	4.54E+05	-1.37E+05	3.85E+04	-	-
1.49E-02	-8.53E-01	4.83E+05	-3.78E+04	3.94E+04	-	-
1.52E-02	1.12E+00	5.12E+05	3.00E+04	4.13E+04	7.93E+03	1.67E+04
1.56E-02	1.02E+00	5.41E+05	3.63E+04	4.53E+04	8.92E+03	1.75E+04
1.59E-02	1.58E+00	5.72E+05	2.50E+04	4.87E+04	6.21E+03	1.89E+04
1.62E-02	-2.88E+00	6.03E+05	-1.33E+04	4.80E+04	-	-
1.65E-02	-4.86E+00	6.34E+05	-7.70E+03	4.79E+04	-	-
1.69E-02	-4.20E+00	6.65E+05	-9.11E+03	4.95E+04	-	-
1.72E-02	-3.16E+00	6.97E+05	-1.15E+04	4.82E+04	-	-
1.75E-02	4.19E-01	7.29E+05	8.54E+04	4.85E+04	2.35E+04	2.26E+04
1.79E-02	-6.86E-01	7.62E+05	-5.34E+04	5.02E+04	-	-
1.82E-02	-2.57E+00	7.95E+05	-1.38E+04	4.98E+04	-	-
1.85E-02	-4.30E+00	8.29E+05	-8.01E+03	4.97E+04	-	-
1.88E-02	-7.31E+00	8.63E+05	-4.82E+03	5.15E+04	-	-
1.92E-02	-4.34E+00	8.97E+05	-8.23E+03	5.29E+04	-	-
1.95E-02	-2.62E+00	9.31E+05	-1.41E+04	5.51E+04	-	-
1.98E-02	-1.82E+00	9.65E+05	-2.00E+04	5.56E+04	-	-
2.01E-02	5.54E-01	1.00E+06	6.41E+04	5.56E+04	2.27E+04	3.27E+04
2.05E-02	3.55E+00	1.04E+06	9.42E+03	5.46E+04	4.45E+03	3.70E+04
2.08E-02	1.08E+00	1.07E+06	2.90E+04	5.37E+04	1.31E+04	3.64E+04
2.11E-02	-5.85E-01	1.11E+06	-5.24E+04	5.40E+04	-	-
2.14E-02	-1.53E+00	1.14E+06	-1.95E+04	5.42E+04	-	-
2.18E-02	5.41E-01	1.18E+06	5.54E+04	5.56E+04	2.60E+04	3.97E+04
2.21E-02	1.09E-01	1.21E+06	2.84E+05	5.79E+04	1.11E+05	3.89E+04
2.24E-02	-2.60E+00	1.25E+06	-1.16E+04	5.83E+04	-	-
2.28E-02	-1.28E+00	1.29E+06	-2.20E+04	5.74E+04	-	-
2.31E-02	6.04E-02	1.32E+06	4.85E+05	5.98E+04	2.00E+05	4.26E+04
2.34E-02	4.92E-01	1.36E+06	5.36E+04	5.83E+04	3.16E+04	4.74E+04
2.37E-02	1.77E+00	1.40E+06	1.35E+04	5.70E+04	1.03E+04	5.14E+04
2.41E-02	1.79E+00	1.43E+06	1.37E+04	5.90E+04	1.05E+04	5.32E+04
2.44E-02	4.42E+00	1.47E+06	5.52E+03	6.03E+04	4.77E+03	5.69E+04
2.47E-02	6.22E+00	1.51E+06	3.77E+03	6.08E+04	3.59E+03	5.96E+04
2.50E-02	7.95E+00	1.55E+06	2.84E+03	6.13E+04	2.94E+03	6.21E+04
2.54E-02	1.21E+01	1.58E+06	2.07E+03	6.51E+04	2.07E+03	6.52E+04
2.57E-02	1.12E+01	1.62E+06	2.29E+03	6.73E+04	2.26E+03	6.69E+04
2.60E-02	1.38E+01	1.66E+06	1.75E+03	6.73E+04	1.91E+03	6.95E+04
2.63E-02	1.65E+01	1.70E+06	1.30E+03	6.61E+04	1.66E+03	7.21E+04
2.67E-02	1.74E+01	1.74E+06	1.20E+03	6.73E+04	1.61E+03	7.44E+04
2.70E-02	1.84E+01	1.77E+06	1.08E+03	6.77E+04	1.56E+03	7.66E+04
2.73E-02	1.73E+01	1.81E+06	1.13E+03	6.90E+04	1.68E+03	7.86E+04
2.76E-02	1.84E+01	1.85E+06	1.04E+03	7.02E+04	1.62E+03	8.09E+04

2.80E-02	2.35E+01	1.89E+06	7.64E+02	7.07E+04	1.33E+03	8.39E+04
2.83E-02	2.78E+01	1.92E+06	6.46E+02	7.24E+04	1.16E+03	8.67E+04
2.86E-02	2.76E+01	1.96E+06	6.25E+02	7.34E+04	1.19E+03	8.90E+04
2.89E-02	2.69E+01	2.00E+06	6.36E+02	7.49E+04	1.24E+03	9.12E+04
2.93E-02	2.89E+01	2.04E+06	5.76E+02	7.62E+04	1.18E+03	9.38E+04
2.96E-02	3.01E+01	2.08E+06	5.51E+02	7.80E+04	1.16E+03	9.63E+04
2.99E-02	3.36E+01	2.11E+06	5.05E+02	8.02E+04	1.07E+03	9.91E+04
3.02E-02	3.32E+01	2.15E+06	5.97E+02	8.49E+04	1.10E+03	1.02E+05
3.06E-02	3.68E+01	2.19E+06	6.70E+02	9.16E+04	1.02E+03	1.04E+05
3.09E-02	3.80E+01	2.23E+06	7.12E+02	9.59E+04	1.01E+03	1.07E+05
3.12E-02	3.86E+01	2.27E+06	6.60E+02	9.62E+04	1.01E+03	1.10E+05
3.15E-02	3.70E+01	2.30E+06	6.49E+02	9.67E+04	1.06E+03	1.12E+05
3.19E-02	3.26E+01	2.34E+06	7.95E+02	1.01E+05	1.21E+03	1.14E+05
3.22E-02	3.18E+01	2.38E+06	8.54E+02	1.04E+05	1.26E+03	1.17E+05
3.25E-02	3.00E+01	2.42E+06	9.28E+02	1.06E+05	1.34E+03	1.19E+05
3.28E-02	2.94E+01	2.45E+06	9.62E+02	1.09E+05	1.39E+03	1.21E+05
3.32E-02	2.97E+01	2.49E+06	9.21E+02	1.10E+05	1.40E+03	1.24E+05
3.35E-02	3.02E+01	2.53E+06	9.31E+02	1.13E+05	1.40E+03	1.27E+05
3.38E-02	3.29E+01	2.56E+06	9.66E+02	1.18E+05	1.31E+03	1.30E+05
3.41E-02	3.45E+01	2.60E+06	1.02E+03	1.24E+05	1.28E+03	1.33E+05
3.45E-02	3.28E+01	2.64E+06	1.14E+03	1.28E+05	1.35E+03	1.35E+05
3.48E-02	3.52E+01	2.67E+06	1.16E+03	1.34E+05	1.29E+03	1.38E+05
3.51E-02	3.71E+01	2.71E+06	1.17E+03	1.39E+05	1.25E+03	1.41E+05
3.54E-02	3.71E+01	2.74E+06	1.20E+03	1.42E+05	1.27E+03	1.44E+05
3.57E-02	3.93E+01	2.78E+06	1.14E+03	1.44E+05	1.22E+03	1.47E+05
3.61E-02	4.08E+01	2.81E+06	1.09E+03	1.46E+05	1.19E+03	1.50E+05
3.64E-02	4.13E+01	2.85E+06	1.09E+03	1.48E+05	1.20E+03	1.53E+05
3.67E-02	4.26E+01	2.88E+06	1.07E+03	1.51E+05	1.18E+03	1.56E+05
3.70E-02	4.37E+01	2.92E+06	1.09E+03	1.56E+05	1.17E+03	1.59E+05
3.73E-02	4.93E+01	2.95E+06	1.00E+03	1.60E+05	1.06E+03	1.63E+05
3.76E-02	5.08E+01	2.99E+06	9.94E+02	1.63E+05	1.05E+03	1.66E+05
3.79E-02	4.86E+01	3.02E+06	1.06E+03	1.66E+05	1.10E+03	1.68E+05
3.82E-02	5.06E+01	3.05E+06	1.01E+03	1.68E+05	1.08E+03	1.71E+05
3.85E-02	5.15E+01	3.08E+06	9.61E+02	1.68E+05	1.07E+03	1.74E+05
3.89E-02	5.61E+01	3.12E+06	9.07E+02	1.72E+05	1.01E+03	1.78E+05
3.92E-02	5.53E+01	3.15E+06	9.64E+02	1.77E+05	1.03E+03	1.80E+05
3.95E-02	5.41E+01	3.18E+06	1.00E+03	1.80E+05	1.07E+03	1.83E+05
3.98E-02	5.53E+01	3.21E+06	9.99E+02	1.83E+05	1.06E+03	1.86E+05
4.01E-02	5.27E+01	3.25E+06	1.05E+03	1.85E+05	1.12E+03	1.89E+05
4.04E-02	5.12E+01	3.28E+06	1.02E+03	1.85E+05	1.16E+03	1.92E+05
4.07E-02	5.25E+01	3.31E+06	9.14E+02	1.83E+05	1.15E+03	1.95E+05
4.10E-02	5.25E+01	3.34E+06	8.54E+02	1.82E+05	1.16E+03	1.98E+05
4.13E-02	5.54E+01	3.37E+06	7.64E+02	1.81E+05	1.12E+03	2.01E+05
4.16E-02	5.68E+01	3.40E+06	6.79E+02	1.80E+05	1.10E+03	2.04E+05
4.19E-02	5.52E+01	3.43E+06	6.45E+02	1.79E+05	1.14E+03	2.07E+05
4.22E-02	5.37E+01	3.46E+06	6.46E+02	1.81E+05	1.19E+03	2.10E+05
4.25E-02	5.30E+01	3.49E+06	6.52E+02	1.83E+05	1.21E+03	2.12E+05

4.28E-02	5.11E+01	3.52E+06	6.83E+02	1.85E+05	1.27E+03	2.15E+05
4.31E-02	5.36E+01	3.55E+06	6.59E+02	1.88E+05	1.23E+03	2.18E+05
4.34E-02	5.52E+01	3.57E+06	6.54E+02	1.91E+05	1.21E+03	2.22E+05
4.37E-02	5.45E+01	3.60E+06	7.06E+02	1.96E+05	1.23E+03	2.25E+05
4.39E-02	5.69E+01	3.63E+06	7.00E+02	1.99E+05	1.20E+03	2.28E+05
4.42E-02	5.64E+01	3.66E+06	7.37E+02	2.03E+05	1.22E+03	2.31E+05
4.45E-02	5.70E+01	3.69E+06	8.07E+02	2.10E+05	1.22E+03	2.34E+05
4.48E-02	5.51E+01	3.71E+06	9.16E+02	2.17E+05	1.27E+03	2.36E+05
4.51E-02	5.70E+01	3.74E+06	9.22E+02	2.21E+05	1.25E+03	2.40E+05
4.54E-02	5.73E+01	3.77E+06	9.29E+02	2.24E+05	1.25E+03	2.43E+05
4.57E-02	5.89E+01	3.79E+06	9.18E+02	2.27E+05	1.23E+03	2.46E+05
4.60E-02	5.89E+01	3.82E+06	9.56E+02	2.32E+05	1.25E+03	2.49E+05
4.62E-02	5.95E+01	3.84E+06	9.82E+02	2.36E+05	1.25E+03	2.52E+05
4.65E-02	5.98E+01	3.87E+06	9.81E+02	2.39E+05	1.25E+03	2.55E+05
4.68E-02	6.17E+01	3.89E+06	9.57E+02	2.41E+05	1.23E+03	2.58E+05
4.71E-02	6.01E+01	3.92E+06	9.77E+02	2.43E+05	1.27E+03	2.61E+05
4.74E-02	5.95E+01	3.95E+06	1.02E+03	2.48E+05	1.29E+03	2.64E+05
4.77E-02	5.93E+01	3.97E+06	1.06E+03	2.52E+05	1.31E+03	2.67E+05
4.80E-02	6.08E+01	4.00E+06	1.03E+03	2.54E+05	1.29E+03	2.70E+05
4.82E-02	6.52E+01	4.02E+06	9.56E+02	2.56E+05	1.22E+03	2.74E+05
4.85E-02	7.04E+01	4.04E+06	9.02E+02	2.60E+05	1.15E+03	2.77E+05
4.88E-02	6.79E+01	4.07E+06	9.34E+02	2.62E+05	1.20E+03	2.80E+05
4.91E-02	6.78E+01	4.09E+06	9.28E+02	2.64E+05	1.21E+03	2.83E+05
4.94E-02	6.52E+01	4.12E+06	9.50E+02	2.65E+05	1.27E+03	2.86E+05
4.97E-02	6.23E+01	4.14E+06	9.95E+02	2.67E+05	1.33E+03	2.88E+05
4.99E-02	6.17E+01	4.16E+06	1.05E+03	2.73E+05	1.36E+03	2.91E+05
5.02E-02	6.00E+01	4.18E+06	1.15E+03	2.79E+05	1.40E+03	2.94E+05
5.05E-02	5.84E+01	4.21E+06	1.22E+03	2.83E+05	1.45E+03	2.97E+05
5.08E-02	5.40E+01	4.23E+06	1.34E+03	2.87E+05	1.57E+03	2.99E+05
5.11E-02	5.31E+01	4.25E+06	1.38E+03	2.90E+05	1.60E+03	3.02E+05
5.13E-02	5.25E+01	4.27E+06	1.42E+03	2.94E+05	1.63E+03	3.05E+05
5.16E-02	5.12E+01	4.29E+06	1.50E+03	2.98E+05	1.68E+03	3.08E+05
5.19E-02	5.17E+01	4.32E+06	1.58E+03	3.05E+05	1.68E+03	3.11E+05
5.22E-02	5.21E+01	4.34E+06	1.64E+03	3.12E+05	1.68E+03	3.14E+05
5.24E-02	5.34E+01	4.36E+06	1.65E+03	3.17E+05	1.66E+03	3.17E+05
5.27E-02	5.42E+01	4.38E+06	1.68E+03	3.22E+05	1.65E+03	3.20E+05
5.30E-02	4.86E+01	4.40E+06	1.94E+03	3.27E+05	1.83E+03	3.22E+05
5.33E-02	4.94E+01	4.42E+06	1.95E+03	3.32E+05	1.82E+03	3.25E+05
5.35E-02	4.92E+01	4.44E+06	1.99E+03	3.35E+05	1.84E+03	3.28E+05
5.38E-02	4.69E+01	4.46E+06	2.14E+03	3.40E+05	1.94E+03	3.31E+05
5.41E-02	4.57E+01	4.48E+06	2.24E+03	3.45E+05	2.00E+03	3.33E+05
5.43E-02	4.56E+01	4.50E+06	2.29E+03	3.49E+05	2.02E+03	3.36E+05
5.46E-02	4.69E+01	4.52E+06	2.27E+03	3.53E+05	1.98E+03	3.40E+05
5.49E-02	4.93E+01	4.54E+06	2.20E+03	3.57E+05	1.91E+03	3.43E+05
5.51E-02	5.06E+01	4.56E+06	2.20E+03	3.63E+05	1.88E+03	3.46E+05
5.54E-02	5.06E+01	4.57E+06	2.26E+03	3.68E+05	1.89E+03	3.49E+05
5.57E-02	5.26E+01	4.59E+06	2.20E+03	3.71E+05	1.84E+03	3.53E+05

5.59E-02	5.18E+01	4.61E+06	2.24E+03	3.74E+05	1.88E+03	3.55E+05
5.62E-02	4.98E+01	4.63E+06	2.33E+03	3.76E+05	1.96E+03	3.58E+05
5.65E-02	4.83E+01	4.65E+06	2.39E+03	3.78E+05	2.03E+03	3.60E+05
5.67E-02	4.94E+01	4.66E+06	2.38E+03	3.82E+05	2.00E+03	3.64E+05
5.70E-02	4.81E+01	4.68E+06	2.47E+03	3.85E+05	2.07E+03	3.66E+05
5.73E-02	5.12E+01	4.70E+06	2.33E+03	3.88E+05	1.97E+03	3.70E+05
5.75E-02	5.52E+01	4.72E+06	2.18E+03	3.91E+05	1.85E+03	3.74E+05
5.78E-02	5.57E+01	4.73E+06	2.17E+03	3.94E+05	1.85E+03	3.77E+05
5.80E-02	5.75E+01	4.75E+06	2.11E+03	3.97E+05	1.81E+03	3.80E+05
5.83E-02	6.13E+01	4.76E+06	2.01E+03	4.01E+05	1.72E+03	3.83E+05
5.85E-02	6.45E+01	4.78E+06	1.93E+03	4.04E+05	1.66E+03	3.87E+05
5.88E-02	6.54E+01	4.80E+06	1.92E+03	4.08E+05	1.65E+03	3.90E+05
5.91E-02	6.87E+01	4.81E+06	1.84E+03	4.11E+05	1.59E+03	3.93E+05
5.93E-02	7.05E+01	4.83E+06	1.80E+03	4.13E+05	1.56E+03	3.97E+05
5.96E-02	7.27E+01	4.84E+06	1.74E+03	4.15E+05	1.53E+03	4.00E+05
5.98E-02	7.55E+01	4.86E+06	1.65E+03	4.15E+05	1.49E+03	4.03E+05
6.01E-02	7.31E+01	4.87E+06	1.64E+03	4.12E+05	1.54E+03	4.05E+05
6.03E-02	7.53E+01	4.89E+06	1.51E+03	4.08E+05	1.51E+03	4.09E+05
6.06E-02	7.48E+01	4.90E+06	1.46E+03	4.06E+05	1.53E+03	4.11E+05
6.08E-02	7.72E+01	4.92E+06	1.39E+03	4.06E+05	1.50E+03	4.15E+05
6.10E-02	8.23E+01	4.93E+06	1.28E+03	4.06E+05	1.42E+03	4.18E+05
6.13E-02	8.39E+01	4.94E+06	1.27E+03	4.09E+05	1.41E+03	4.21E+05
6.15E-02	8.53E+01	4.96E+06	1.24E+03	4.11E+05	1.40E+03	4.24E+05
6.18E-02	8.95E+01	4.97E+06	1.17E+03	4.12E+05	1.34E+03	4.28E+05
6.20E-02	9.17E+01	4.99E+06	1.10E+03	4.10E+05	1.32E+03	4.31E+05
6.23E-02	9.33E+01	5.00E+06	1.03E+03	4.07E+05	1.31E+03	4.34E+05
6.25E-02	9.63E+01	5.01E+06	9.53E+02	4.05E+05	1.28E+03	4.37E+05
6.27E-02	1.00E+02	5.03E+06	8.92E+02	4.05E+05	1.25E+03	4.40E+05
6.30E-02	1.03E+02	5.04E+06	8.34E+02	4.03E+05	1.22E+03	4.43E+05
6.32E-02	1.06E+02	5.05E+06	7.75E+02	4.01E+05	1.20E+03	4.46E+05
6.34E-02	1.09E+02	5.06E+06	7.14E+02	3.99E+05	1.18E+03	4.49E+05
6.37E-02	1.09E+02	5.08E+06	6.69E+02	3.96E+05	1.18E+03	4.52E+05
6.39E-02	1.13E+02	5.09E+06	6.21E+02	3.95E+05	1.15E+03	4.55E+05
6.41E-02	1.17E+02	5.10E+06	5.88E+02	3.96E+05	1.12E+03	4.58E+05
6.44E-02	1.17E+02	5.11E+06	5.85E+02	3.97E+05	1.13E+03	4.61E+05
6.46E-02	1.21E+02	5.12E+06	5.79E+02	4.01E+05	1.10E+03	4.64E+05
6.48E-02	1.22E+02	5.13E+06	5.75E+02	4.03E+05	1.09E+03	4.67E+05
6.50E-02	1.23E+02	5.15E+06	5.71E+02	4.05E+05	1.09E+03	4.69E+05
6.53E-02	1.29E+02	5.16E+06	5.43E+02	4.06E+05	1.06E+03	4.73E+05
6.55E-02	1.29E+02	5.17E+06	5.45E+02	4.09E+05	1.06E+03	4.75E+05
6.57E-02	1.28E+02	5.18E+06	5.53E+02	4.11E+05	1.07E+03	4.78E+05
6.59E-02	1.29E+02	5.19E+06	5.58E+02	4.14E+05	1.07E+03	4.80E+05
6.61E-02	1.29E+02	5.20E+06	5.68E+02	4.17E+05	1.08E+03	4.83E+05
6.64E-02	1.29E+02	5.21E+06	5.76E+02	4.20E+05	1.08E+03	4.85E+05
6.66E-02	1.29E+02	5.22E+06	5.84E+02	4.23E+05	1.08E+03	4.88E+05
6.68E-02	1.28E+02	5.23E+06	5.90E+02	4.25E+05	1.10E+03	4.90E+05
6.70E-02	1.29E+02	5.24E+06	5.93E+02	4.28E+05	1.10E+03	4.93E+05

6.72E-02	1.27E+02	5.25E+06	6.17E+02	4.31E+05	1.12E+03	4.95E+05
6.74E-02	1.24E+02	5.26E+06	6.51E+02	4.35E+05	1.15E+03	4.97E+05
6.76E-02	1.22E+02	5.27E+06	6.75E+02	4.39E+05	1.17E+03	4.99E+05
6.78E-02	1.22E+02	5.28E+06	7.05E+02	4.44E+05	1.18E+03	5.01E+05
6.80E-02	1.23E+02	5.29E+06	7.25E+02	4.49E+05	1.17E+03	5.04E+05
6.82E-02	1.21E+02	5.30E+06	7.63E+02	4.54E+05	1.20E+03	5.06E+05
6.84E-02	1.23E+02	5.31E+06	7.89E+02	4.60E+05	1.19E+03	5.09E+05
6.86E-02	1.22E+02	5.32E+06	8.18E+02	4.65E+05	1.20E+03	5.11E+05
6.88E-02	1.20E+02	5.32E+06	8.62E+02	4.70E+05	1.22E+03	5.13E+05
6.90E-02	1.19E+02	5.33E+06	8.96E+02	4.75E+05	1.24E+03	5.15E+05
6.92E-02	1.18E+02	5.34E+06	9.31E+02	4.80E+05	1.25E+03	5.17E+05
6.94E-02	1.18E+02	5.35E+06	9.68E+02	4.85E+05	1.26E+03	5.19E+05
6.96E-02	1.16E+02	5.36E+06	1.03E+03	4.92E+05	1.28E+03	5.21E+05
6.98E-02	1.15E+02	5.37E+06	1.06E+03	4.97E+05	1.30E+03	5.24E+05
7.00E-02	1.14E+02	5.38E+06	1.10E+03	5.02E+05	1.31E+03	5.26E+05
7.02E-02	1.14E+02	5.38E+06	1.14E+03	5.08E+05	1.32E+03	5.28E+05
7.04E-02	1.14E+02	5.39E+06	1.19E+03	5.14E+05	1.33E+03	5.30E+05
7.06E-02	1.13E+02	5.40E+06	1.22E+03	5.19E+05	1.34E+03	5.32E+05
7.08E-02	1.14E+02	5.41E+06	1.24E+03	5.24E+05	1.34E+03	5.34E+05
7.09E-02	1.11E+02	5.41E+06	1.29E+03	5.27E+05	1.37E+03	5.36E+05
7.11E-02	1.09E+02	5.42E+06	1.33E+03	5.31E+05	1.39E+03	5.38E+05
7.13E-02	1.07E+02	5.43E+06	1.38E+03	5.34E+05	1.43E+03	5.40E+05
7.15E-02	1.05E+02	5.44E+06	1.40E+03	5.37E+05	1.45E+03	5.41E+05
7.17E-02	1.03E+02	5.44E+06	1.45E+03	5.39E+05	1.49E+03	5.43E+05
7.18E-02	9.96E+01	5.45E+06	1.50E+03	5.41E+05	1.54E+03	5.45E+05
7.20E-02	1.00E+02	5.46E+06	1.49E+03	5.42E+05	1.53E+03	5.47E+05
7.22E-02	9.64E+01	5.47E+06	1.56E+03	5.45E+05	1.59E+03	5.48E+05
7.24E-02	9.73E+01	5.47E+06	1.56E+03	5.48E+05	1.59E+03	5.50E+05
7.25E-02	9.82E+01	5.48E+06	1.55E+03	5.50E+05	1.58E+03	5.52E+05
7.27E-02	9.73E+01	5.49E+06	1.58E+03	5.52E+05	1.60E+03	5.54E+05
7.29E-02	9.71E+01	5.49E+06	1.61E+03	5.56E+05	1.61E+03	5.56E+05
7.30E-02	9.53E+01	5.50E+06	1.67E+03	5.60E+05	1.64E+03	5.58E+05
7.32E-02	9.48E+01	5.51E+06	1.69E+03	5.63E+05	1.65E+03	5.60E+05
7.34E-02	9.67E+01	5.51E+06	1.68E+03	5.67E+05	1.63E+03	5.62E+05
7.35E-02	9.61E+01	5.52E+06	1.74E+03	5.72E+05	1.64E+03	5.64E+05
7.37E-02	9.67E+01	5.52E+06	1.74E+03	5.76E+05	1.64E+03	5.66E+05
7.38E-02	9.89E+01	5.53E+06	1.72E+03	5.79E+05	1.61E+03	5.68E+05
7.40E-02	9.93E+01	5.54E+06	1.72E+03	5.80E+05	1.61E+03	5.70E+05
7.41E-02	9.98E+01	5.54E+06	1.71E+03	5.81E+05	1.61E+03	5.72E+05
7.43E-02	9.89E+01	5.55E+06	1.71E+03	5.82E+05	1.63E+03	5.73E+05
7.45E-02	1.01E+02	5.55E+06	1.66E+03	5.81E+05	1.60E+03	5.75E+05
7.46E-02	1.02E+02	5.56E+06	1.62E+03	5.80E+05	1.60E+03	5.77E+05
7.48E-02	1.04E+02	5.57E+06	1.56E+03	5.79E+05	1.57E+03	5.79E+05
7.49E-02	1.06E+02	5.57E+06	1.50E+03	5.77E+05	1.55E+03	5.82E+05
7.51E-02	1.06E+02	5.58E+06	1.46E+03	5.74E+05	1.55E+03	5.83E+05
7.52E-02	1.07E+02	5.58E+06	1.41E+03	5.71E+05	1.55E+03	5.85E+05
7.53E-02	1.07E+02	5.59E+06	1.37E+03	5.69E+05	1.54E+03	5.87E+05

7.55E-02	1.09E+02	5.59E+06	1.32E+03	5.66E+05	1.53E+03	5.89E+05
7.56E-02	1.10E+02	5.60E+06	1.29E+03	5.65E+05	1.52E+03	5.91E+05
7.58E-02	1.10E+02	5.60E+06	1.26E+03	5.63E+05	1.52E+03	5.92E+05
7.59E-02	1.11E+02	5.61E+06	1.23E+03	5.62E+05	1.52E+03	5.94E+05
7.60E-02	1.14E+02	5.61E+06	1.19E+03	5.62E+05	1.48E+03	5.96E+05
7.62E-02	1.17E+02	5.62E+06	1.14E+03	5.62E+05	1.45E+03	5.98E+05
7.63E-02	1.17E+02	5.62E+06	1.15E+03	5.64E+05	1.46E+03	6.00E+05
7.64E-02	1.21E+02	5.63E+06	1.12E+03	5.65E+05	1.43E+03	6.02E+05
7.66E-02	1.22E+02	5.63E+06	1.11E+03	5.68E+05	1.41E+03	6.04E+05
7.67E-02	1.21E+02	5.64E+06	1.13E+03	5.69E+05	1.43E+03	6.05E+05
7.68E-02	1.23E+02	5.64E+06	1.12E+03	5.71E+05	1.41E+03	6.07E+05
7.70E-02	1.23E+02	5.65E+06	1.13E+03	5.73E+05	1.42E+03	6.08E+05
7.71E-02	1.23E+02	5.65E+06	1.13E+03	5.74E+05	1.42E+03	6.10E+05
7.72E-02	1.23E+02	5.65E+06	1.13E+03	5.76E+05	1.42E+03	6.11E+05
7.73E-02	1.24E+02	5.66E+06	1.13E+03	5.77E+05	1.42E+03	6.13E+05
7.74E-02	1.25E+02	5.66E+06	1.12E+03	5.78E+05	1.41E+03	6.14E+05
7.76E-02	1.27E+02	5.67E+06	1.10E+03	5.79E+05	1.39E+03	6.16E+05
7.77E-02	1.29E+02	5.67E+06	1.09E+03	5.81E+05	1.38E+03	6.18E+05
7.78E-02	1.32E+02	5.68E+06	1.07E+03	5.83E+05	1.35E+03	6.20E+05
7.79E-02	1.35E+02	5.68E+06	1.06E+03	5.85E+05	1.33E+03	6.21E+05
7.80E-02	1.36E+02	5.68E+06	1.06E+03	5.88E+05	1.32E+03	6.23E+05
7.81E-02	1.36E+02	5.69E+06	1.08E+03	5.92E+05	1.32E+03	6.24E+05
7.82E-02	1.39E+02	5.69E+06	1.07E+03	5.94E+05	1.30E+03	6.26E+05
7.83E-02	1.39E+02	5.69E+06	1.08E+03	5.96E+05	1.30E+03	6.27E+05
7.84E-02	1.38E+02	5.70E+06	1.10E+03	5.98E+05	1.31E+03	6.28E+05
7.85E-02	1.39E+02	5.70E+06	1.09E+03	6.00E+05	1.31E+03	6.30E+05
7.86E-02	1.41E+02	5.71E+06	1.08E+03	6.01E+05	1.29E+03	6.31E+05
7.87E-02	1.44E+02	5.71E+06	1.06E+03	6.02E+05	1.27E+03	6.33E+05
7.88E-02	1.45E+02	5.71E+06	1.06E+03	6.04E+05	1.27E+03	6.34E+05
7.89E-02	1.45E+02	5.72E+06	1.06E+03	6.06E+05	1.27E+03	6.35E+05
7.90E-02	1.45E+02	5.72E+06	1.07E+03	6.08E+05	1.27E+03	6.36E+05
7.91E-02	1.46E+02	5.72E+06	1.08E+03	6.10E+05	1.27E+03	6.38E+05
7.92E-02	1.45E+02	5.72E+06	1.09E+03	6.11E+05	1.27E+03	6.39E+05
7.93E-02	1.46E+02	5.73E+06	1.08E+03	6.12E+05	1.27E+03	6.40E+05
7.94E-02	1.46E+02	5.73E+06	1.08E+03	6.12E+05	1.28E+03	6.41E+05
7.95E-02	1.46E+02	5.73E+06	1.07E+03	6.11E+05	1.28E+03	6.42E+05
7.96E-02	1.46E+02	5.74E+06	1.05E+03	6.10E+05	1.28E+03	6.43E+05
7.96E-02	1.46E+02	5.74E+06	1.03E+03	6.07E+05	1.28E+03	6.44E+05
7.97E-02	1.46E+02	5.74E+06	1.01E+03	6.05E+05	1.28E+03	6.45E+05
7.98E-02	1.45E+02	5.74E+06	9.95E+02	6.02E+05	1.29E+03	6.45E+05
7.99E-02	1.48E+02	5.75E+06	9.49E+02	5.99E+05	1.27E+03	6.47E+05
7.99E-02	1.48E+02	5.75E+06	9.21E+02	5.96E+05	1.27E+03	6.48E+05
8.00E-02	1.47E+02	5.75E+06	9.11E+02	5.94E+05	1.28E+03	6.48E+05
8.01E-02	1.47E+02	5.75E+06	8.95E+02	5.92E+05	1.28E+03	6.49E+05
8.02E-02	1.45E+02	5.76E+06	8.96E+02	5.91E+05	1.30E+03	6.50E+05
8.02E-02	1.44E+02	5.76E+06	9.00E+02	5.92E+05	1.31E+03	6.51E+05
8.03E-02	1.44E+02	5.76E+06	9.07E+02	5.93E+05	1.31E+03	6.51E+05

8.04E-02	1.43E+02	5.76E+06	9.15E+02	5.94E+05	1.32E+03	6.52E+05
8.04E-02	1.44E+02	5.77E+06	9.21E+02	5.96E+05	1.31E+03	6.53E+05
8.05E-02	1.43E+02	5.77E+06	9.32E+02	5.98E+05	1.32E+03	6.53E+05
8.05E-02	1.45E+02	5.77E+06	9.39E+02	6.00E+05	1.31E+03	6.54E+05
8.06E-02	1.46E+02	5.77E+06	9.42E+02	6.02E+05	1.30E+03	6.55E+05
8.06E-02	1.46E+02	5.77E+06	9.56E+02	6.05E+05	1.30E+03	6.56E+05
8.07E-02	1.45E+02	5.77E+06	9.77E+02	6.08E+05	1.31E+03	6.56E+05
8.07E-02	1.46E+02	5.78E+06	9.83E+02	6.10E+05	1.31E+03	6.57E+05
8.08E-02	1.45E+02	5.78E+06	1.00E+03	6.12E+05	1.32E+03	6.57E+05
8.08E-02	1.44E+02	5.78E+06	1.02E+03	6.15E+05	1.32E+03	6.58E+05
8.09E-02	1.43E+02	5.78E+06	1.04E+03	6.17E+05	1.33E+03	6.58E+05
8.09E-02	1.41E+02	5.78E+06	1.07E+03	6.19E+05	1.35E+03	6.59E+05
8.10E-02	1.41E+02	5.78E+06	1.08E+03	6.22E+05	1.35E+03	6.59E+05
8.10E-02	1.38E+02	5.79E+06	1.12E+03	6.24E+05	1.38E+03	6.59E+05
8.10E-02	1.37E+02	5.79E+06	1.14E+03	6.26E+05	1.39E+03	6.59E+05
8.11E-02	1.34E+02	5.79E+06	1.19E+03	6.28E+05	1.42E+03	6.59E+05
8.11E-02	1.33E+02	5.79E+06	1.21E+03	6.30E+05	1.43E+03	6.60E+05
8.11E-02	1.32E+02	5.79E+06	1.22E+03	6.32E+05	1.44E+03	6.60E+05
8.12E-02	1.31E+02	5.79E+06	1.25E+03	6.33E+05	1.45E+03	6.60E+05
8.12E-02	1.30E+02	5.79E+06	1.27E+03	6.35E+05	1.47E+03	6.60E+05
8.12E-02	1.26E+02	5.79E+06	1.31E+03	6.37E+05	1.50E+03	6.60E+05
8.13E-02	1.24E+02	5.79E+06	1.35E+03	6.38E+05	1.53E+03	6.60E+05
8.13E-02	1.21E+02	5.79E+06	1.39E+03	6.39E+05	1.56E+03	6.60E+05
8.13E-02	1.20E+02	5.80E+06	1.41E+03	6.40E+05	1.57E+03	6.60E+05
8.13E-02	1.18E+02	5.80E+06	1.43E+03	6.40E+05	1.59E+03	6.60E+05
8.13E-02	1.18E+02	5.80E+06	1.43E+03	6.41E+05	1.59E+03	6.60E+05
8.14E-02	1.18E+02	5.80E+06	1.44E+03	6.42E+05	1.59E+03	6.60E+05
8.14E-02	1.19E+02	5.80E+06	1.44E+03	6.43E+05	1.58E+03	6.61E+05
8.14E-02	1.18E+02	5.80E+06	1.45E+03	6.44E+05	1.59E+03	6.61E+05
8.14E-02	1.18E+02	5.80E+06	1.47E+03	6.45E+05	1.60E+03	6.61E+05
8.14E-02	1.19E+02	5.80E+06	1.47E+03	6.46E+05	1.59E+03	6.61E+05
8.14E-02	1.18E+02	5.80E+06	1.48E+03	6.47E+05	1.60E+03	6.61E+05
8.14E-02	1.17E+02	5.80E+06	1.50E+03	6.48E+05	1.61E+03	6.61E+05
8.14E-02	1.15E+02	5.80E+06	1.52E+03	6.47E+05	1.63E+03	6.61E+05
8.14E-02	1.14E+02	5.80E+06	1.53E+03	6.47E+05	1.64E+03	6.60E+05
8.15E-02	1.15E+02	5.80E+06	1.51E+03	6.46E+05	1.64E+03	6.61E+05
8.15E-02	1.15E+02	5.80E+06	1.49E+03	6.44E+05	1.64E+03	6.61E+05
8.15E-02	1.15E+02	5.80E+06	1.45E+03	6.40E+05	1.63E+03	6.61E+05
8.14E-02	1.15E+02	5.80E+06	1.42E+03	6.37E+05	1.63E+03	6.61E+05
8.14E-02	1.15E+02	5.80E+06	1.40E+03	6.33E+05	1.64E+03	6.60E+05
8.14E-02	1.17E+02	5.80E+06	1.35E+03	6.30E+05	1.61E+03	6.61E+05
8.14E-02	1.19E+02	5.80E+06	1.29E+03	6.26E+05	1.58E+03	6.61E+05
8.14E-02	1.19E+02	5.80E+06	1.27E+03	6.23E+05	1.59E+03	6.61E+05
8.14E-02	1.21E+02	5.80E+06	1.22E+03	6.20E+05	1.57E+03	6.61E+05
8.14E-02	1.22E+02	5.80E+06	1.18E+03	6.16E+05	1.55E+03	6.61E+05
8.14E-02	1.21E+02	5.80E+06	1.16E+03	6.13E+05	1.56E+03	6.61E+05
8.14E-02	1.21E+02	5.80E+06	1.14E+03	6.09E+05	1.56E+03	6.61E+05

8.14E-02	1.21E+02	5.80E+06	1.10E+03	6.05E+05	1.56E+03	6.61E+05
8.13E-02	1.23E+02	5.80E+06	1.05E+03	6.01E+05	1.54E+03	6.61E+05
8.13E-02	1.24E+02	5.80E+06	1.00E+03	5.96E+05	1.52E+03	6.61E+05
8.13E-02	1.26E+02	5.79E+06	9.57E+02	5.91E+05	1.51E+03	6.61E+05
8.13E-02	1.28E+02	5.79E+06	9.03E+02	5.86E+05	1.49E+03	6.61E+05
8.12E-02	1.29E+02	5.79E+06	8.50E+02	5.81E+05	1.47E+03	6.61E+05
8.12E-02	1.31E+02	5.79E+06	7.92E+02	5.75E+05	1.45E+03	6.61E+05
8.12E-02	1.32E+02	5.79E+06	7.42E+02	5.68E+05	1.44E+03	6.60E+05
8.12E-02	1.34E+02	5.79E+06	6.78E+02	5.61E+05	1.42E+03	6.60E+05
8.11E-02	1.34E+02	5.79E+06	6.28E+02	5.54E+05	1.42E+03	6.60E+05
8.11E-02	1.37E+02	5.79E+06	5.66E+02	5.47E+05	1.39E+03	6.60E+05
8.11E-02	1.36E+02	5.79E+06	5.19E+02	5.40E+05	1.40E+03	6.59E+05
8.10E-02	1.39E+02	5.79E+06	4.54E+02	5.32E+05	1.37E+03	6.60E+05
8.10E-02	1.40E+02	5.78E+06	4.03E+02	5.25E+05	1.36E+03	6.59E+05
8.10E-02	1.41E+02	5.78E+06	3.54E+02	5.18E+05	1.36E+03	6.59E+05
8.09E-02	1.41E+02	5.78E+06	3.13E+02	5.12E+05	1.35E+03	6.58E+05
8.09E-02	1.43E+02	5.78E+06	2.83E+02	5.08E+05	1.34E+03	6.58E+05
8.08E-02	1.42E+02	5.78E+06	2.55E+02	5.03E+05	1.34E+03	6.57E+05
8.08E-02	1.41E+02	5.78E+06	2.41E+02	5.01E+05	1.35E+03	6.57E+05
8.07E-02	1.40E+02	5.78E+06	2.33E+02	4.99E+05	1.35E+03	6.56E+05
8.07E-02	1.39E+02	5.77E+06	2.31E+02	4.98E+05	1.37E+03	6.55E+05
8.06E-02	1.37E+02	5.77E+06	2.39E+02	4.98E+05	1.38E+03	6.54E+05
8.06E-02	1.34E+02	5.77E+06	2.52E+02	4.99E+05	1.40E+03	6.53E+05
8.05E-02	1.33E+02	5.77E+06	2.70E+02	5.00E+05	1.42E+03	6.52E+05
8.05E-02	1.31E+02	5.77E+06	2.92E+02	5.02E+05	1.43E+03	6.51E+05
8.04E-02	1.31E+02	5.77E+06	3.23E+02	5.06E+05	1.43E+03	6.51E+05
8.03E-02	1.29E+02	5.76E+06	3.53E+02	5.09E+05	1.44E+03	6.50E+05
8.03E-02	1.30E+02	5.76E+06	3.78E+02	5.12E+05	1.44E+03	6.49E+05
8.02E-02	1.28E+02	5.76E+06	4.00E+02	5.13E+05	1.45E+03	6.48E+05
8.02E-02	1.25E+02	5.76E+06	4.22E+02	5.14E+05	1.48E+03	6.47E+05
8.01E-02	1.25E+02	5.75E+06	4.28E+02	5.14E+05	1.48E+03	6.46E+05
8.00E-02	1.21E+02	5.75E+06	4.46E+02	5.14E+05	1.52E+03	6.45E+05
8.00E-02	1.18E+02	5.75E+06	4.58E+02	5.14E+05	1.56E+03	6.43E+05
7.99E-02	1.15E+02	5.75E+06	4.64E+02	5.13E+05	1.59E+03	6.42E+05
7.98E-02	1.12E+02	5.75E+06	4.68E+02	5.11E+05	1.62E+03	6.41E+05
7.97E-02	1.13E+02	5.74E+06	4.51E+02	5.09E+05	1.61E+03	6.40E+05
7.97E-02	1.11E+02	5.74E+06	4.47E+02	5.07E+05	1.64E+03	6.39E+05
7.96E-02	1.08E+02	5.74E+06	4.49E+02	5.05E+05	1.68E+03	6.37E+05
7.95E-02	1.07E+02	5.74E+06	4.41E+02	5.03E+05	1.68E+03	6.36E+05
7.94E-02	1.06E+02	5.73E+06	4.39E+02	5.02E+05	1.70E+03	6.35E+05
7.94E-02	1.04E+02	5.73E+06	4.43E+02	5.01E+05	1.72E+03	6.34E+05
7.93E-02	1.02E+02	5.73E+06	4.48E+02	5.00E+05	1.75E+03	6.32E+05
7.92E-02	1.01E+02	5.72E+06	4.46E+02	4.99E+05	1.75E+03	6.31E+05
7.91E-02	1.00E+02	5.72E+06	4.43E+02	4.97E+05	1.77E+03	6.30E+05
7.90E-02	1.00E+02	5.72E+06	4.32E+02	4.95E+05	1.77E+03	6.29E+05
7.89E-02	9.80E+01	5.72E+06	4.33E+02	4.94E+05	1.80E+03	6.27E+05
7.89E-02	9.53E+01	5.71E+06	4.33E+02	4.92E+05	1.84E+03	6.26E+05

7.88E-02	9.46E+01	5.71E+06	4.12E+02	4.89E+05	1.85E+03	6.25E+05
7.87E-02	9.60E+01	5.71E+06	3.73E+02	4.85E+05	1.82E+03	6.24E+05
7.86E-02	9.41E+01	5.70E+06	3.38E+02	4.80E+05	1.85E+03	6.22E+05
7.85E-02	9.18E+01	5.70E+06	3.07E+02	4.76E+05	1.89E+03	6.21E+05
7.84E-02	8.98E+01	5.70E+06	2.74E+02	4.71E+05	1.92E+03	6.19E+05
7.83E-02	8.74E+01	5.69E+06	2.36E+02	4.66E+05	1.97E+03	6.18E+05
7.82E-02	8.49E+01	5.69E+06	1.92E+02	4.61E+05	2.01E+03	6.16E+05
7.81E-02	8.30E+01	5.69E+06	1.44E+02	4.56E+05	2.05E+03	6.14E+05
7.80E-02	7.98E+01	5.68E+06	9.49E+01	4.51E+05	2.12E+03	6.13E+05
7.79E-02	7.96E+01	5.68E+06	3.44E+01	4.45E+05	2.12E+03	6.11E+05
7.78E-02	7.79E+01	5.68E+06	-2.39E+01	4.40E+05	2.16E+03	6.10E+05
7.77E-02	7.75E+01	5.67E+06	-8.27E+01	4.34E+05	2.17E+03	6.09E+05
7.76E-02	7.73E+01	5.67E+06	-1.50E+02	4.28E+05	2.17E+03	6.07E+05
7.75E-02	7.72E+01	5.67E+06	-2.17E+02	4.22E+05	2.16E+03	6.06E+05
7.74E-02	7.75E+01	5.66E+06	-2.81E+02	4.16E+05	2.15E+03	6.05E+05
7.73E-02	7.68E+01	5.66E+06	-3.53E+02	4.10E+05	2.16E+03	6.03E+05
7.72E-02	7.64E+01	5.65E+06	-4.13E+02	4.05E+05	2.17E+03	6.02E+05
7.71E-02	7.54E+01	5.65E+06	-4.72E+02	4.00E+05	2.19E+03	6.01E+05
7.70E-02	7.51E+01	5.65E+06	-5.19E+02	3.96E+05	2.19E+03	5.99E+05
7.68E-02	7.60E+01	5.64E+06	-5.58E+02	3.91E+05	2.17E+03	5.98E+05
7.67E-02	7.70E+01	5.64E+06	-5.95E+02	3.87E+05	2.14E+03	5.97E+05
7.66E-02	7.71E+01	5.63E+06	-6.29E+02	3.83E+05	2.13E+03	5.96E+05
7.65E-02	7.62E+01	5.63E+06	-6.74E+02	3.79E+05	2.15E+03	5.94E+05
7.64E-02	7.46E+01	5.63E+06	-7.25E+02	3.76E+05	2.18E+03	5.93E+05
7.63E-02	7.55E+01	5.62E+06	-7.56E+02	3.72E+05	2.15E+03	5.91E+05
7.62E-02	7.56E+01	5.62E+06	-8.02E+02	3.67E+05	2.15E+03	5.90E+05
7.60E-02	7.45E+01	5.61E+06	-8.65E+02	3.62E+05	2.17E+03	5.88E+05
7.59E-02	7.42E+01	5.61E+06	-9.33E+02	3.57E+05	2.17E+03	5.87E+05
7.58E-02	7.42E+01	5.60E+06	-1.00E+03	3.51E+05	2.17E+03	5.86E+05
7.57E-02	7.20E+01	5.60E+06	-1.10E+03	3.45E+05	2.22E+03	5.84E+05
7.56E-02	7.14E+01	5.60E+06	-1.18E+03	3.39E+05	2.23E+03	5.82E+05
7.54E-02	7.16E+01	5.59E+06	-1.24E+03	3.33E+05	2.22E+03	5.81E+05
7.53E-02	6.96E+01	5.59E+06	-1.35E+03	3.27E+05	2.27E+03	5.79E+05
7.52E-02	6.92E+01	5.58E+06	-1.43E+03	3.20E+05	2.28E+03	5.77E+05
7.51E-02	6.78E+01	5.58E+06	-1.53E+03	3.15E+05	2.31E+03	5.75E+05
7.49E-02	6.69E+01	5.57E+06	-1.61E+03	3.10E+05	2.34E+03	5.74E+05
7.48E-02	6.70E+01	5.57E+06	-1.68E+03	3.04E+05	2.32E+03	5.72E+05
7.47E-02	6.53E+01	5.56E+06	-1.78E+03	2.99E+05	2.37E+03	5.70E+05
7.45E-02	6.62E+01	5.56E+06	-1.83E+03	2.93E+05	2.34E+03	5.69E+05
7.44E-02	6.56E+01	5.55E+06	-1.91E+03	2.88E+05	2.35E+03	5.67E+05
7.43E-02	6.36E+01	5.55E+06	-2.05E+03	2.81E+05	2.41E+03	5.65E+05
7.42E-02	6.15E+01	5.54E+06	-2.21E+03	2.75E+05	2.48E+03	5.63E+05
7.40E-02	6.00E+01	5.54E+06	-2.35E+03	2.69E+05	2.52E+03	5.61E+05
7.39E-02	6.00E+01	5.53E+06	-2.42E+03	2.63E+05	2.52E+03	5.60E+05
7.38E-02	5.95E+01	5.53E+06	-2.53E+03	2.57E+05	2.53E+03	5.58E+05
7.36E-02	5.87E+01	5.52E+06	-2.64E+03	2.52E+05	2.55E+03	5.56E+05
7.35E-02	5.88E+01	5.52E+06	-2.71E+03	2.46E+05	2.54E+03	5.55E+05

7.33E-02	5.84E+01	5.51E+06	-2.81E+03	2.40E+05	2.55E+03	5.53E+05
7.32E-02	5.91E+01	5.51E+06	-2.86E+03	2.34E+05	2.52E+03	5.52E+05
7.31E-02	5.88E+01	5.50E+06	-2.95E+03	2.28E+05	2.52E+03	5.50E+05
7.29E-02	5.91E+01	5.50E+06	-3.02E+03	2.23E+05	2.50E+03	5.49E+05
7.28E-02	5.86E+01	5.49E+06	-3.11E+03	2.17E+05	2.52E+03	5.47E+05
7.27E-02	5.76E+01	5.48E+06	-3.25E+03	2.12E+05	2.55E+03	5.45E+05
7.25E-02	5.70E+01	5.48E+06	-3.35E+03	2.06E+05	2.56E+03	5.43E+05
7.24E-02	5.60E+01	5.47E+06	-3.50E+03	2.00E+05	2.60E+03	5.41E+05
7.22E-02	5.48E+01	5.47E+06	-3.65E+03	1.95E+05	2.64E+03	5.40E+05
7.21E-02	5.36E+01	5.46E+06	-3.81E+03	1.90E+05	2.68E+03	5.38E+05
7.20E-02	5.31E+01	5.46E+06	-3.91E+03	1.85E+05	2.70E+03	5.36E+05
7.18E-02	5.23E+01	5.45E+06	-4.03E+03	1.81E+05	2.72E+03	5.34E+05
7.17E-02	5.06E+01	5.44E+06	-4.24E+03	1.76E+05	2.80E+03	5.32E+05
7.15E-02	5.02E+01	5.44E+06	-4.33E+03	1.72E+05	2.81E+03	5.30E+05
7.14E-02	4.97E+01	5.43E+06	-4.44E+03	1.67E+05	2.82E+03	5.28E+05
7.12E-02	4.81E+01	5.43E+06	-4.65E+03	1.63E+05	2.90E+03	5.26E+05
7.11E-02	4.74E+01	5.42E+06	-4.78E+03	1.59E+05	2.93E+03	5.24E+05
7.09E-02	4.51E+01	5.41E+06	-5.08E+03	1.55E+05	3.05E+03	5.22E+05
7.08E-02	4.23E+01	5.41E+06	-5.46E+03	1.52E+05	3.22E+03	5.19E+05
7.06E-02	4.07E+01	5.40E+06	-5.72E+03	1.49E+05	3.33E+03	5.17E+05
7.05E-02	4.01E+01	5.40E+06	-5.83E+03	1.46E+05	3.36E+03	5.15E+05
7.03E-02	3.86E+01	5.39E+06	-6.10E+03	1.44E+05	3.46E+03	5.13E+05
7.02E-02	3.84E+01	5.38E+06	-6.17E+03	1.41E+05	3.47E+03	5.11E+05
7.00E-02	3.80E+01	5.38E+06	-6.29E+03	1.38E+05	3.49E+03	5.09E+05
6.99E-02	3.69E+01	5.37E+06	-6.52E+03	1.35E+05	3.57E+03	5.07E+05
6.97E-02	3.67E+01	5.36E+06	-6.62E+03	1.31E+05	3.57E+03	5.05E+05
6.96E-02	3.53E+01	5.36E+06	-6.95E+03	1.27E+05	3.69E+03	5.03E+05
6.94E-02	3.26E+01	5.35E+06	-7.59E+03	1.24E+05	3.94E+03	5.00E+05
6.93E-02	3.15E+01	5.34E+06	-7.95E+03	1.20E+05	4.06E+03	4.98E+05
6.91E-02	3.07E+01	5.34E+06	-8.25E+03	1.16E+05	4.14E+03	4.96E+05
6.90E-02	2.75E+01	5.33E+06	-9.32E+03	1.11E+05	4.54E+03	4.93E+05
6.88E-02	2.67E+01	5.32E+06	-9.73E+03	1.06E+05	4.64E+03	4.91E+05
6.87E-02	2.61E+01	5.32E+06	-1.01E+04	1.02E+05	4.73E+03	4.89E+05
6.85E-02	2.61E+01	5.31E+06	-1.02E+04	9.72E+04	4.71E+03	4.87E+05
6.84E-02	2.53E+01	5.30E+06	-1.07E+04	9.29E+04	4.82E+03	4.85E+05
6.82E-02	2.47E+01	5.30E+06	-1.10E+04	8.99E+04	4.91E+03	4.83E+05
6.81E-02	2.37E+01	5.29E+06	-1.15E+04	8.73E+04	5.08E+03	4.81E+05
6.79E-02	2.28E+01	5.28E+06	-1.20E+04	8.54E+04	5.24E+03	4.78E+05
6.78E-02	2.34E+01	5.28E+06	-1.17E+04	8.43E+04	5.10E+03	4.77E+05
6.76E-02	2.40E+01	5.27E+06	-1.14E+04	8.27E+04	4.98E+03	4.76E+05
6.74E-02	2.33E+01	5.26E+06	-1.17E+04	8.19E+04	5.08E+03	4.73E+05
6.73E-02	2.22E+01	5.25E+06	-1.23E+04	8.15E+04	5.29E+03	4.71E+05
6.71E-02	1.97E+01	5.25E+06	-1.38E+04	8.09E+04	5.87E+03	4.68E+05
6.70E-02	1.92E+01	5.24E+06	-1.40E+04	8.08E+04	5.97E+03	4.66E+05
6.68E-02	1.89E+01	5.23E+06	-1.43E+04	8.06E+04	6.06E+03	4.64E+05
6.67E-02	1.64E+01	5.22E+06	-1.63E+04	7.97E+04	6.82E+03	4.60E+05
6.65E-02	1.62E+01	5.22E+06	-1.66E+04	7.87E+04	6.89E+03	4.59E+05

6.64E-02	1.50E+01	5.21E+06	-1.79E+04	7.76E+04	7.34E+03	4.56E+05
6.62E-02	1.35E+01	5.20E+06	-1.98E+04	7.70E+04	8.04E+03	4.53E+05
6.60E-02	1.15E+01	5.19E+06	-2.31E+04	7.68E+04	9.21E+03	4.49E+05
6.59E-02	1.05E+01	5.19E+06	-2.52E+04	7.61E+04	9.95E+03	4.47E+05
6.57E-02	8.48E+00	5.18E+06	-3.12E+04	7.57E+04	1.20E+04	4.42E+05
6.56E-02	8.45E+00	5.17E+06	-3.13E+04	7.48E+04	1.20E+04	4.41E+05
6.54E-02	6.44E+00	5.16E+06	-4.11E+04	7.33E+04	1.53E+04	4.36E+05
6.52E-02	4.31E+00	5.16E+06	-6.15E+04	7.14E+04	2.17E+04	4.30E+05
6.51E-02	2.06E+00	5.15E+06	-1.29E+05	6.92E+04	4.18E+04	4.21E+05
6.49E-02	1.50E+00	5.14E+06	-1.78E+05	6.71E+04	5.53E+04	4.16E+05
6.48E-02	4.59E-01	5.13E+06	-5.84E+05	6.46E+04	1.58E+05	4.05E+05
6.46E-02	7.51E-01	5.12E+06	-3.59E+05	6.14E+04	1.01E+05	4.07E+05
6.45E-02	-2.31E-02	5.12E+06	1.18E+07	5.81E+04	-	-
6.43E-02	-2.20E+00	5.11E+06	1.24E+05	5.47E+04	-	-
6.42E-02	-2.70E+00	5.10E+06	1.02E+05	5.18E+04	-	-
6.40E-02	-2.34E+00	5.09E+06	1.18E+05	4.92E+04	-	-
6.39E-02	-2.22E+00	5.09E+06	1.25E+05	4.69E+04	-	-
6.37E-02	-2.71E+00	5.08E+06	1.03E+05	4.48E+04	-	-
6.36E-02	-2.30E+00	5.07E+06	1.22E+05	4.28E+04	-	-
6.34E-02	-3.53E+00	5.06E+06	7.95E+04	4.06E+04	-	-
6.33E-02	-3.90E+00	5.05E+06	7.21E+04	3.85E+04	-	-
6.31E-02	-5.19E+00	5.05E+06	5.44E+04	3.63E+04	-	-
6.30E-02	-5.68E+00	5.04E+06	4.98E+04	3.42E+04	-	-
6.29E-02	-5.68E+00	5.03E+06	5.00E+04	3.23E+04	-	-
6.27E-02	-4.19E+00	5.02E+06	6.80E+04	3.00E+04	-	-
6.26E-02	-4.01E+00	5.02E+06	7.13E+04	2.76E+04	-	-
6.24E-02	-3.59E+00	5.01E+06	8.01E+04	2.51E+04	-	-
6.23E-02	-3.00E+00	5.00E+06	9.63E+04	2.27E+04	-	-
6.21E-02	-3.02E+00	4.99E+06	9.60E+04	2.06E+04	-	-
6.20E-02	-2.31E+00	4.98E+06	1.25E+05	1.91E+04	-	-
6.19E-02	-2.69E+00	4.98E+06	1.08E+05	1.74E+04	-	-
6.17E-02	-3.96E+00	4.97E+06	7.35E+04	1.59E+04	-	-
6.16E-02	-5.53E+00	4.96E+06	5.27E+04	1.40E+04	-	-
6.14E-02	-5.86E+00	4.95E+06	4.99E+04	1.16E+04	-	-
6.13E-02	-5.70E+00	4.95E+06	5.15E+04	9.24E+03	-	-
6.12E-02	-5.94E+00	4.94E+06	4.97E+04	6.59E+03	-	-
6.10E-02	-5.81E+00	4.93E+06	5.11E+04	3.85E+03	-	-
6.09E-02	-6.04E+00	4.92E+06	4.93E+04	1.86E+03	-	-
6.08E-02	-6.19E+00	4.92E+06	4.82E+04	2.18E+02	-	-
6.06E-02	-6.83E+00	4.91E+06	4.36E+04	0.00E+00	-	-
6.05E-02	-6.97E+00	4.90E+06	4.26E+04	0.00E+00	-	-
6.04E-02	-7.57E+00	4.89E+06	3.90E+04	0.00E+00	-	-
6.03E-02	-7.24E+00	4.89E+06	4.07E+04	0.00E+00	-	-
6.02E-02	-8.05E+00	4.88E+06	3.65E+04	0.00E+00	-	-
6.01E-02	-7.73E+00	4.87E+06	3.79E+04	0.00E+00	-	-
5.99E-02	-7.35E+00	4.87E+06	3.97E+04	0.00E+00	-	-
5.98E-02	-8.65E+00	4.86E+06	3.36E+04	0.00E+00	-	-

5.97E-02	-7.75E+00	4.85E+06	3.74E+04	0.00E+00	-	-
5.96E-02	-6.12E+00	4.85E+06	4.72E+04	0.00E+00	-	-
5.96E-02	-5.00E+00	4.84E+06	5.77E+04	0.00E+00	-	-
5.95E-02	-4.45E+00	4.84E+06	6.46E+04	0.00E+00	-	-
5.94E-02	-3.83E+00	4.83E+06	7.48E+04	0.00E+00	-	-
5.93E-02	-2.43E+00	4.83E+06	1.18E+05	0.00E+00	-	-
5.92E-02	-1.37E+00	4.82E+06	2.08E+05	0.00E+00	-	-
5.91E-02	-1.29E+00	4.82E+06	2.21E+05	0.00E+00	-	-
5.90E-02	-2.05E+00	4.81E+06	1.39E+05	0.00E+00	-	-
5.90E-02	-2.84E+00	4.81E+06	1.00E+05	0.00E+00	-	-
5.89E-02	-2.62E+00	4.80E+06	1.08E+05	0.00E+00	-	-
5.89E-02	-2.19E+00	4.80E+06	1.29E+05	0.00E+00	-	-
5.88E-02	-2.44E+00	4.80E+06	1.16E+05	0.00E+00	-	-
5.88E-02	-1.00E+00	4.80E+06	2.81E+05	0.00E+00	-	-
5.87E-02	-8.37E-01	4.79E+06	3.36E+05	0.00E+00	-	-
5.87E-02	-4.15E-01	4.79E+06	6.78E+05	0.00E+00	-	-
5.87E-02	-6.81E-01	4.79E+06	4.13E+05	0.00E+00	-	-
5.87E-02	-6.85E-01	4.79E+06	4.10E+05	0.00E+00	-	-
5.87E-02	-1.85E+00	4.79E+06	1.52E+05	0.00E+00	-	-
5.87E-02	-1.83E+00	4.79E+06	1.53E+05	0.00E+00	-	-
5.87E-02	-1.48E+00	4.79E+06	1.90E+05	0.00E+00	-	-
5.87E-02	-1.82E+00	4.79E+06	1.55E+05	0.00E+00	-	-
5.87E-02	-1.48E+00	4.79E+06	1.90E+05	0.00E+00	-	-
5.88E-02	-2.23E+00	4.79E+06	1.27E+05	0.00E+00	-	-
5.88E-02	-2.53E+00	4.80E+06	1.11E+05	0.00E+00	-	-
5.88E-02	-2.08E+00	4.80E+06	1.36E+05	0.00E+00	-	-
5.89E-02	-3.19E+00	4.80E+06	8.87E+04	0.00E+00	-	-
5.89E-02	-3.93E+00	4.80E+06	7.20E+04	0.00E+00	-	-
5.90E-02	-4.31E+00	4.81E+06	6.59E+04	0.00E+00	-	-
5.90E-02	-4.62E+00	4.81E+06	6.15E+04	0.00E+00	-	-
5.91E-02	-5.37E+00	4.82E+06	5.30E+04	0.00E+00	-	-
5.92E-02	-5.97E+00	4.82E+06	4.78E+04	0.00E+00	-	-
5.92E-02	-6.49E+00	4.82E+06	4.40E+04	0.00E+00	-	-
5.93E-02	-7.38E+00	4.83E+06	3.88E+04	0.00E+00	-	-
5.94E-02	-8.15E+00	4.83E+06	3.52E+04	0.00E+00	-	-
5.95E-02	-9.40E+00	4.84E+06	3.06E+04	0.00E+00	-	-
5.95E-02	-1.06E+01	4.84E+06	2.72E+04	0.00E+00	-	-
5.96E-02	-1.09E+01	4.85E+06	2.65E+04	0.00E+00	-	-
5.97E-02	-9.65E+00	4.85E+06	3.00E+04	0.00E+00	-	-
5.98E-02	-9.31E+00	4.86E+06	3.12E+04	0.00E+00	-	-
5.99E-02	-8.47E+00	4.86E+06	3.44E+04	0.00E+00	-	-
6.00E-02	-8.97E+00	4.87E+06	3.25E+04	0.00E+00	-	-
6.01E-02	-8.89E+00	4.87E+06	3.29E+04	0.00E+00	-	-
6.02E-02	-8.19E+00	4.88E+06	3.58E+04	0.00E+00	-	-
6.02E-02	-7.21E+00	4.88E+06	4.08E+04	0.00E+00	-	-
6.03E-02	-7.17E+00	4.89E+06	4.11E+04	0.00E+00	-	-
6.04E-02	-7.57E+00	4.89E+06	3.90E+04	0.00E+00	-	-

6.05E-02	-7.03E+00	4.90E+06	4.21E+04	0.00E+00	-	-
6.06E-02	-7.91E+00	4.90E+06	3.76E+04	0.00E+00	-	-
6.07E-02	-7.61E+00	4.91E+06	3.92E+04	0.00E+00	-	-
6.07E-02	-7.70E+00	4.91E+06	3.88E+04	0.00E+00	-	-
6.08E-02	-7.76E+00	4.92E+06	3.86E+04	0.00E+00	-	-
6.09E-02	-7.98E+00	4.92E+06	3.76E+04	0.00E+00	-	-
6.10E-02	-7.91E+00	4.93E+06	3.79E+04	0.00E+00	-	-
6.10E-02	-7.57E+00	4.93E+06	3.98E+04	0.00E+00	-	-
6.11E-02	-7.74E+00	4.93E+06	3.90E+04	0.00E+00	-	-
6.12E-02	-7.38E+00	4.94E+06	4.09E+04	0.00E+00	-	-
6.12E-02	-6.66E+00	4.94E+06	4.55E+04	0.00E+00	-	-
6.13E-02	-6.98E+00	4.95E+06	4.34E+04	0.00E+00	-	-
6.14E-02	-6.95E+00	4.95E+06	4.37E+04	0.00E+00	-	-
6.14E-02	-9.09E+00	4.95E+06	3.35E+04	0.00E+00	-	-
6.15E-02	-9.11E+00	4.96E+06	3.35E+04	0.00E+00	-	-
6.16E-02	-7.52E+00	4.96E+06	4.06E+04	0.00E+00	-	-
6.17E-02	-5.96E+00	4.97E+06	5.13E+04	0.00E+00	-	-
6.17E-02	-5.57E+00	4.97E+06	5.51E+04	0.00E+00	-	-
6.18E-02	-4.67E+00	4.97E+06	6.58E+04	0.00E+00	-	-
6.19E-02	-4.11E+00	4.98E+06	7.49E+04	0.00E+00	-	-
6.20E-02	-3.00E+00	4.98E+06	1.03E+05	0.00E+00	-	-
6.20E-02	-2.39E+00	4.99E+06	1.29E+05	0.00E+00	-	-
6.21E-02	-2.84E+00	4.99E+06	1.09E+05	0.00E+00	-	-
6.22E-02	-2.51E+00	5.00E+06	1.24E+05	0.00E+00	-	-
6.23E-02	-1.86E+00	5.00E+06	1.67E+05	0.00E+00	-	-
6.24E-02	-1.41E+00	5.00E+06	2.22E+05	0.00E+00	-	-
6.24E-02	-3.67E-01	5.01E+06	8.52E+05	0.00E+00	-	-
6.25E-02	8.14E-01	5.01E+06	-3.85E+05	0.00E+00	8.97E+04	3.86E+05
6.26E-02	1.92E+00	5.02E+06	-1.63E+05	0.00E+00	4.18E+04	3.94E+05
6.26E-02	2.66E+00	5.02E+06	-1.18E+05	0.00E+00	3.14E+04	3.98E+05
6.27E-02	3.94E+00	5.02E+06	-7.99E+04	0.00E+00	2.22E+04	4.02E+05
6.27E-02	5.22E+00	5.03E+06	-6.04E+04	0.00E+00	1.73E+04	4.05E+05
6.28E-02	5.11E+00	5.03E+06	-6.18E+04	0.00E+00	1.76E+04	4.06E+05
6.28E-02	6.61E+00	5.03E+06	-4.78E+04	0.00E+00	1.40E+04	4.09E+05
6.29E-02	8.49E+00	5.03E+06	-3.73E+04	0.00E+00	1.12E+04	4.12E+05
6.29E-02	8.84E+00	5.04E+06	-3.58E+04	0.00E+00	1.08E+04	4.13E+05
6.30E-02	9.11E+00	5.04E+06	-3.48E+04	0.00E+00	1.06E+04	4.14E+05
6.30E-02	8.16E+00	5.04E+06	-3.89E+04	0.00E+00	1.17E+04	4.13E+05
6.31E-02	7.64E+00	5.04E+06	-4.16E+04	0.00E+00	1.24E+04	4.13E+05
6.31E-02	8.53E+00	5.05E+06	-3.74E+04	0.00E+00	1.13E+04	4.14E+05
6.32E-02	8.75E+00	5.05E+06	-3.64E+04	0.00E+00	1.10E+04	4.15E+05
6.32E-02	9.42E+00	5.05E+06	-3.39E+04	0.00E+00	1.03E+04	4.16E+05
6.32E-02	9.33E+00	5.05E+06	-3.42E+04	0.00E+00	1.04E+04	4.17E+05
6.33E-02	9.66E+00	5.05E+06	-3.31E+04	0.00E+00	1.01E+04	4.17E+05
6.33E-02	9.58E+00	5.06E+06	-3.34E+04	0.00E+00	1.02E+04	4.18E+05
6.33E-02	9.42E+00	5.06E+06	-3.40E+04	0.00E+00	1.04E+04	4.18E+05
6.33E-02	8.38E+00	5.06E+06	-3.82E+04	0.00E+00	1.15E+04	4.17E+05

6.34E-02	8.07E+00	5.06E+06	-3.97E+04	0.00E+00	1.19E+04	4.17E+05
6.34E-02	8.42E+00	5.06E+06	-3.81E+04	0.00E+00	1.15E+04	4.17E+05
6.34E-02	8.43E+00	5.06E+06	-3.80E+04	0.00E+00	1.14E+04	4.17E+05
6.34E-02	8.16E+00	5.06E+06	-3.93E+04	0.00E+00	1.18E+04	4.17E+05
6.34E-02	7.54E+00	5.06E+06	-4.26E+04	0.00E+00	1.26E+04	4.16E+05
6.34E-02	7.77E+00	5.06E+06	-4.14E+04	0.00E+00	1.23E+04	4.17E+05
6.35E-02	7.90E+00	5.06E+06	-4.07E+04	0.00E+00	1.22E+04	4.17E+05
6.35E-02	7.52E+00	5.06E+06	-4.27E+04	0.00E+00	1.27E+04	4.17E+05
6.35E-02	6.19E+00	5.06E+06	-5.19E+04	0.00E+00	1.51E+04	4.15E+05
6.35E-02	5.36E+00	5.06E+06	-6.00E+04	0.00E+00	1.72E+04	4.13E+05
6.35E-02	5.21E+00	5.06E+06	-6.17E+04	0.00E+00	1.76E+04	4.13E+05
6.35E-02	5.69E+00	5.06E+06	-5.65E+04	0.00E+00	1.63E+04	4.14E+05
6.35E-02	5.63E+00	5.06E+06	-5.71E+04	0.00E+00	1.64E+04	4.14E+05
6.35E-02	6.09E+00	5.06E+06	-5.28E+04	0.00E+00	1.53E+04	4.15E+05
6.34E-02	5.19E+00	5.06E+06	-6.18E+04	0.00E+00	1.76E+04	4.13E+05
6.34E-02	4.86E+00	5.06E+06	-6.60E+04	0.00E+00	1.87E+04	4.12E+05
6.34E-02	5.38E+00	5.06E+06	-5.96E+04	0.00E+00	1.71E+04	4.13E+05
6.34E-02	5.28E+00	5.06E+06	-6.08E+04	0.00E+00	1.74E+04	4.12E+05
6.34E-02	4.87E+00	5.06E+06	-6.59E+04	0.00E+00	1.86E+04	4.11E+05
6.33E-02	5.27E+00	5.06E+06	-6.08E+04	0.00E+00	1.74E+04	4.12E+05
6.33E-02	6.24E+00	5.06E+06	-5.13E+04	0.00E+00	1.49E+04	4.13E+05
6.33E-02	6.25E+00	5.05E+06	-5.12E+04	0.00E+00	1.49E+04	4.13E+05
6.33E-02	6.20E+00	5.05E+06	-5.16E+04	0.00E+00	1.50E+04	4.13E+05
6.32E-02	5.49E+00	5.05E+06	-5.82E+04	0.00E+00	1.67E+04	4.11E+05
6.32E-02	5.64E+00	5.05E+06	-5.66E+04	0.00E+00	1.63E+04	4.11E+05
6.32E-02	5.62E+00	5.05E+06	-5.68E+04	0.00E+00	1.63E+04	4.11E+05
6.32E-02	5.85E+00	5.05E+06	-5.45E+04	0.00E+00	1.57E+04	4.11E+05
6.31E-02	5.00E+00	5.05E+06	-6.37E+04	0.00E+00	1.81E+04	4.09E+05
6.31E-02	5.22E+00	5.05E+06	-6.10E+04	0.00E+00	1.74E+04	4.09E+05
6.31E-02	6.16E+00	5.04E+06	-5.17E+04	0.00E+00	1.50E+04	4.11E+05
6.31E-02	6.32E+00	5.04E+06	-5.03E+04	0.00E+00	1.47E+04	4.11E+05
6.30E-02	6.24E+00	5.04E+06	-5.10E+04	0.00E+00	1.48E+04	4.10E+05
6.30E-02	6.38E+00	5.04E+06	-4.98E+04	0.00E+00	1.45E+04	4.10E+05
6.30E-02	5.43E+00	5.04E+06	-5.85E+04	0.00E+00	1.68E+04	4.09E+05
6.30E-02	5.77E+00	5.04E+06	-5.50E+04	0.00E+00	1.59E+04	4.09E+05
6.30E-02	6.51E+00	5.04E+06	-4.88E+04	0.00E+00	1.43E+04	4.10E+05
6.29E-02	6.54E+00	5.04E+06	-4.85E+04	0.00E+00	1.42E+04	4.10E+05
6.29E-02	7.12E+00	5.04E+06	-4.45E+04	0.00E+00	1.32E+04	4.10E+05
6.29E-02	7.36E+00	5.03E+06	-4.30E+04	0.00E+00	1.28E+04	4.11E+05
6.29E-02	8.00E+00	5.03E+06	-3.96E+04	0.00E+00	1.19E+04	4.11E+05
6.29E-02	8.02E+00	5.03E+06	-3.94E+04	0.00E+00	1.18E+04	4.11E+05
6.28E-02	7.09E+00	5.03E+06	-4.46E+04	0.00E+00	1.32E+04	4.09E+05
6.28E-02	6.98E+00	5.03E+06	-4.53E+04	0.00E+00	1.34E+04	4.09E+05
6.28E-02	7.85E+00	5.03E+06	-4.02E+04	0.00E+00	1.20E+04	4.10E+05
6.27E-02	8.42E+00	5.03E+06	-3.75E+04	0.00E+00	1.13E+04	4.10E+05
6.27E-02	9.18E+00	5.02E+06	-3.43E+04	0.00E+00	1.04E+04	4.11E+05
6.27E-02	8.66E+00	5.02E+06	-3.64E+04	0.00E+00	1.10E+04	4.10E+05

6.27E-02	9.06E+00	5.02E+06	-3.47E+04	0.00E+00	1.05E+04	4.10E+05
6.26E-02	8.69E+00	5.02E+06	-3.62E+04	0.00E+00	1.09E+04	4.09E+05
6.26E-02	8.44E+00	5.02E+06	-3.72E+04	0.00E+00	1.12E+04	4.09E+05
6.26E-02	8.22E+00	5.02E+06	-3.82E+04	0.00E+00	1.15E+04	4.08E+05
6.25E-02	7.87E+00	5.01E+06	-3.99E+04	0.00E+00	1.19E+04	4.07E+05
6.25E-02	7.45E+00	5.01E+06	-4.20E+04	0.00E+00	1.25E+04	4.07E+05
6.25E-02	8.42E+00	5.01E+06	-3.72E+04	0.00E+00	1.12E+04	4.07E+05
6.24E-02	7.95E+00	5.01E+06	-3.93E+04	0.00E+00	1.18E+04	4.06E+05
6.24E-02	7.50E+00	5.01E+06	-4.17E+04	0.00E+00	1.24E+04	4.05E+05
6.23E-02	7.52E+00	5.00E+06	-4.15E+04	0.00E+00	1.24E+04	4.05E+05
6.23E-02	6.42E+00	5.00E+06	-4.86E+04	0.00E+00	1.42E+04	4.03E+05
6.23E-02	6.08E+00	5.00E+06	-5.12E+04	0.00E+00	1.49E+04	4.02E+05
6.22E-02	5.56E+00	5.00E+06	-5.59E+04	0.00E+00	1.61E+04	4.01E+05
6.22E-02	4.03E+00	5.00E+06	-7.71E+04	0.00E+00	2.14E+04	3.97E+05
6.22E-02	3.73E+00	4.99E+06	-8.32E+04	0.00E+00	2.30E+04	3.96E+05
6.21E-02	3.85E+00	4.99E+06	-8.06E+04	0.00E+00	2.23E+04	3.96E+05
6.21E-02	3.02E+00	4.99E+06	-1.02E+05	0.00E+00	2.76E+04	3.93E+05
6.20E-02	2.58E+00	4.99E+06	-1.20E+05	0.00E+00	3.17E+04	3.91E+05
6.20E-02	1.46E+00	4.98E+06	-2.11E+05	0.00E+00	5.26E+04	3.86E+05
6.20E-02	2.38E-01	4.98E+06	-1.30E+06	0.00E+00	2.65E+05	3.72E+05
6.19E-02	-6.06E-01	4.98E+06	5.09E+05	0.00E+00	-	-
6.19E-02	-8.38E-01	4.98E+06	3.68E+05	0.00E+00	-	-
6.19E-02	-1.14E+00	4.98E+06	2.69E+05	0.00E+00	-	-
6.18E-02	-1.59E+00	4.98E+06	1.94E+05	0.00E+00	-	-
6.18E-02	-2.32E+00	4.97E+06	1.32E+05	0.00E+00	-	-
6.18E-02	-2.74E+00	4.97E+06	1.12E+05	0.00E+00	-	-
6.18E-02	-3.63E+00	4.97E+06	8.47E+04	0.00E+00	-	-
6.17E-02	-4.44E+00	4.97E+06	6.90E+04	0.00E+00	-	-
6.17E-02	-6.07E+00	4.97E+06	5.05E+04	0.00E+00	-	-
6.17E-02	-6.63E+00	4.97E+06	4.62E+04	0.00E+00	-	-
6.16E-02	-6.66E+00	4.96E+06	4.59E+04	0.00E+00	-	-
6.16E-02	-6.84E+00	4.96E+06	4.47E+04	0.00E+00	-	-
6.16E-02	-7.46E+00	4.96E+06	4.09E+04	0.00E+00	-	-
6.15E-02	-6.93E+00	4.96E+06	4.40E+04	0.00E+00	-	-
6.15E-02	-7.31E+00	4.96E+06	4.17E+04	0.00E+00	-	-
6.15E-02	-8.48E+00	4.95E+06	3.59E+04	0.00E+00	-	-
6.14E-02	-9.10E+00	4.95E+06	3.34E+04	0.00E+00	-	-
6.14E-02	-9.68E+00	4.95E+06	3.14E+04	0.00E+00	-	-
6.13E-02	-9.61E+00	4.95E+06	3.16E+04	0.00E+00	-	-
6.13E-02	-9.81E+00	4.94E+06	3.09E+04	0.00E+00	-	-
6.12E-02	-1.01E+01	4.94E+06	3.01E+04	0.00E+00	-	-
6.12E-02	-9.91E+00	4.94E+06	3.05E+04	0.00E+00	-	-
6.11E-02	-1.02E+01	4.93E+06	2.94E+04	0.00E+00	-	-
6.10E-02	-1.13E+01	4.93E+06	2.65E+04	0.00E+00	-	-
6.10E-02	-1.14E+01	4.93E+06	2.64E+04	0.00E+00	-	-
6.09E-02	-1.13E+01	4.92E+06	2.65E+04	0.00E+00	-	-
6.08E-02	-1.10E+01	4.92E+06	2.71E+04	0.00E+00	-	-

6.07E-02	-1.18E+01	4.91E+06	2.54E+04	0.00E+00	-	-
6.07E-02	-1.10E+01	4.91E+06	2.71E+04	0.00E+00	-	-
6.06E-02	-1.02E+01	4.90E+06	2.91E+04	0.00E+00	-	-
6.05E-02	-1.01E+01	4.90E+06	2.93E+04	0.00E+00	-	-
6.04E-02	-9.48E+00	4.89E+06	3.12E+04	0.00E+00	-	-
6.03E-02	-9.12E+00	4.89E+06	3.23E+04	0.00E+00	-	-
6.02E-02	-9.16E+00	4.88E+06	3.21E+04	0.00E+00	-	-
6.01E-02	-8.44E+00	4.88E+06	3.48E+04	0.00E+00	-	-
6.01E-02	-8.19E+00	4.87E+06	3.57E+04	0.00E+00	-	-
6.00E-02	-7.68E+00	4.87E+06	3.80E+04	0.00E+00	-	-
5.99E-02	-6.76E+00	4.86E+06	4.31E+04	0.00E+00	-	-
5.98E-02	-6.24E+00	4.86E+06	4.66E+04	0.00E+00	-	-
5.97E-02	-5.67E+00	4.85E+06	5.12E+04	0.00E+00	-	-
5.97E-02	-5.60E+00	4.85E+06	5.17E+04	0.00E+00	-	-
5.96E-02	-5.67E+00	4.85E+06	5.10E+04	0.00E+00	-	-
5.95E-02	-5.88E+00	4.84E+06	4.90E+04	0.00E+00	-	-
5.95E-02	-5.75E+00	4.84E+06	5.00E+04	0.00E+00	-	-
5.94E-02	-5.40E+00	4.84E+06	5.33E+04	0.00E+00	-	-
5.94E-02	-4.50E+00	4.83E+06	6.38E+04	0.00E+00	-	-
5.93E-02	-4.12E+00	4.83E+06	6.96E+04	0.00E+00	-	-
5.93E-02	-3.35E+00	4.83E+06	8.53E+04	0.00E+00	-	-
5.92E-02	-3.39E+00	4.82E+06	8.44E+04	0.00E+00	-	-
5.92E-02	-3.20E+00	4.82E+06	8.93E+04	0.00E+00	-	-
5.92E-02	-2.81E+00	4.82E+06	1.02E+05	0.00E+00	-	-
5.91E-02	-3.16E+00	4.82E+06	9.02E+04	0.00E+00	-	-
5.91E-02	-2.55E+00	4.81E+06	1.12E+05	0.00E+00	-	-
5.91E-02	-1.84E+00	4.81E+06	1.54E+05	0.00E+00	-	-
5.90E-02	-1.50E+00	4.81E+06	1.90E+05	0.00E+00	-	-
5.90E-02	-8.43E-01	4.81E+06	3.37E+05	0.00E+00	-	-
5.90E-02	-8.66E-01	4.81E+06	3.28E+05	0.00E+00	-	-
5.90E-02	-1.64E+00	4.81E+06	1.73E+05	0.00E+00	-	-
5.90E-02	-7.91E-01	4.81E+06	3.59E+05	0.00E+00	-	-
5.90E-02	-1.24E+00	4.81E+06	2.29E+05	0.00E+00	-	-
5.90E-02	-2.26E+00	4.81E+06	1.25E+05	0.00E+00	-	-
5.90E-02	-2.01E+00	4.81E+06	1.42E+05	0.00E+00	-	-
5.90E-02	-2.40E+00	4.81E+06	1.18E+05	0.00E+00	-	-
5.90E-02	-3.17E+00	4.81E+06	8.95E+04	0.00E+00	-	-
5.91E-02	-3.06E+00	4.81E+06	9.29E+04	0.00E+00	-	-
5.91E-02	-3.59E+00	4.82E+06	7.92E+04	0.00E+00	-	-
5.91E-02	-3.15E+00	4.82E+06	9.05E+04	0.00E+00	-	-
5.92E-02	-3.05E+00	4.82E+06	9.35E+04	0.00E+00	-	-
5.92E-02	-2.99E+00	4.82E+06	9.54E+04	0.00E+00	-	-
5.93E-02	-2.62E+00	4.83E+06	1.09E+05	0.00E+00	-	-
5.94E-02	-2.78E+00	4.83E+06	1.03E+05	0.00E+00	-	-
5.94E-02	-2.27E+00	4.84E+06	1.27E+05	0.00E+00	-	-
5.95E-02	-1.89E+00	4.84E+06	1.52E+05	0.00E+00	-	-
5.96E-02	-2.35E+00	4.85E+06	1.23E+05	0.00E+00	-	-

5.97E-02	-2.01E+00	4.85E+06	1.44E+05	0.00E+00	-	-
5.98E-02	-3.47E+00	4.86E+06	8.38E+04	0.00E+00	-	-
5.99E-02	-3.68E+00	4.86E+06	7.92E+04	0.00E+00	-	-
6.00E-02	-3.53E+00	4.87E+06	8.28E+04	0.00E+00	-	-
6.02E-02	-4.21E+00	4.88E+06	6.96E+04	0.00E+00	-	-
6.03E-02	-3.79E+00	4.89E+06	7.77E+04	0.00E+00	-	-
6.04E-02	-3.28E+00	4.89E+06	9.01E+04	0.00E+00	-	-
6.05E-02	-3.28E+00	4.90E+06	9.05E+04	0.00E+00	-	-
6.06E-02	-3.97E+00	4.91E+06	7.50E+04	0.00E+00	-	-
6.08E-02	-4.39E+00	4.91E+06	6.80E+04	0.00E+00	-	-
6.09E-02	-4.77E+00	4.92E+06	6.29E+04	0.00E+00	-	-
6.10E-02	-4.41E+00	4.93E+06	6.82E+04	0.00E+00	-	-
6.11E-02	-4.86E+00	4.94E+06	6.21E+04	0.00E+00	-	-
6.12E-02	-4.97E+00	4.94E+06	6.09E+04	0.00E+00	-	-
6.14E-02	-5.83E+00	4.95E+06	5.21E+04	0.00E+00	-	-
6.15E-02	-5.62E+00	4.96E+06	5.42E+04	0.00E+00	-	-
6.16E-02	-5.94E+00	4.96E+06	5.15E+04	0.00E+00	-	-
6.17E-02	-5.23E+00	4.97E+06	5.86E+04	0.00E+00	-	-
6.18E-02	-4.92E+00	4.97E+06	6.24E+04	0.00E+00	-	-
6.19E-02	-4.60E+00	4.98E+06	6.70E+04	0.00E+00	-	-
6.20E-02	-4.70E+00	4.99E+06	6.58E+04	0.00E+00	-	-
6.21E-02	-4.25E+00	4.99E+06	7.29E+04	0.00E+00	-	-
6.22E-02	-4.49E+00	5.00E+06	6.93E+04	0.00E+00	-	-
6.23E-02	-4.41E+00	5.00E+06	7.06E+04	0.00E+00	-	-
6.24E-02	-4.36E+00	5.01E+06	7.16E+04	0.00E+00	-	-
6.25E-02	-3.71E+00	5.01E+06	8.44E+04	0.00E+00	-	-
6.26E-02	-3.55E+00	5.02E+06	8.85E+04	0.00E+00	-	-
6.27E-02	-2.29E+00	5.02E+06	1.38E+05	0.00E+00	-	-
6.28E-02	-2.19E+00	5.03E+06	1.44E+05	0.00E+00	-	-
6.28E-02	-1.38E+00	5.03E+06	2.28E+05	0.00E+00	-	-
6.29E-02	-1.65E-01	5.03E+06	1.91E+06	0.00E+00	-	-
6.30E-02	6.38E-01	5.04E+06	-4.98E+05	0.00E+00	1.13E+05	3.89E+05
6.31E-02	1.34E+00	5.04E+06	-2.37E+05	0.00E+00	5.82E+04	3.96E+05
6.31E-02	2.27E+00	5.05E+06	-1.40E+05	0.00E+00	3.65E+04	4.01E+05
6.32E-02	3.12E+00	5.05E+06	-1.02E+05	0.00E+00	2.76E+04	4.05E+05
6.32E-02	3.78E+00	5.05E+06	-8.46E+04	0.00E+00	2.33E+04	4.08E+05
6.33E-02	4.53E+00	5.06E+06	-7.07E+04	0.00E+00	1.99E+04	4.10E+05
6.34E-02	5.20E+00	5.06E+06	-6.16E+04	0.00E+00	1.76E+04	4.12E+05
6.34E-02	5.27E+00	5.06E+06	-6.09E+04	0.00E+00	1.74E+04	4.13E+05
6.35E-02	5.63E+00	5.06E+06	-5.70E+04	0.00E+00	1.64E+04	4.14E+05
6.35E-02	6.12E+00	5.07E+06	-5.25E+04	0.00E+00	1.53E+04	4.15E+05
6.35E-02	5.80E+00	5.07E+06	-5.55E+04	0.00E+00	1.60E+04	4.15E+05
6.36E-02	6.66E+00	5.07E+06	-4.84E+04	0.00E+00	1.42E+04	4.17E+05
6.36E-02	6.95E+00	5.07E+06	-4.65E+04	0.00E+00	1.37E+04	4.18E+05
6.37E-02	7.09E+00	5.07E+06	-4.55E+04	0.00E+00	1.34E+04	4.18E+05
6.37E-02	8.26E+00	5.08E+06	-3.91E+04	0.00E+00	1.17E+04	4.20E+05
6.37E-02	8.33E+00	5.08E+06	-3.89E+04	0.00E+00	1.17E+04	4.21E+05

6.38E-02	8.80E+00	5.08E+06	-3.68E+04	0.00E+00	1.11E+04	4.22E+05
6.38E-02	9.41E+00	5.08E+06	-3.44E+04	0.00E+00	1.05E+04	4.23E+05
6.38E-02	9.39E+00	5.08E+06	-3.45E+04	0.00E+00	1.05E+04	4.23E+05
6.38E-02	9.42E+00	5.08E+06	-3.44E+04	0.00E+00	1.05E+04	4.23E+05
6.38E-02	9.81E+00	5.08E+06	-3.31E+04	0.00E+00	1.01E+04	4.24E+05
6.38E-02	8.97E+00	5.08E+06	-3.62E+04	0.00E+00	1.09E+04	4.23E+05
6.39E-02	9.31E+00	5.08E+06	-3.49E+04	0.00E+00	1.06E+04	4.23E+05
6.39E-02	9.53E+00	5.08E+06	-3.41E+04	0.00E+00	1.04E+04	4.24E+05
6.39E-02	9.98E+00	5.08E+06	-3.25E+04	0.00E+00	9.96E+03	4.24E+05
6.39E-02	1.04E+01	5.08E+06	-3.11E+04	0.00E+00	9.56E+03	4.25E+05
6.38E-02	1.00E+01	5.08E+06	-3.25E+04	0.00E+00	9.94E+03	4.24E+05
6.38E-02	9.70E+00	5.08E+06	-3.35E+04	0.00E+00	1.02E+04	4.24E+05
6.38E-02	9.56E+00	5.08E+06	-3.40E+04	0.00E+00	1.03E+04	4.23E+05
6.38E-02	9.47E+00	5.08E+06	-3.43E+04	0.00E+00	1.04E+04	4.23E+05
6.38E-02	9.93E+00	5.08E+06	-3.27E+04	0.00E+00	1.00E+04	4.24E+05
6.38E-02	8.91E+00	5.08E+06	-3.64E+04	0.00E+00	1.10E+04	4.22E+05
6.38E-02	8.80E+00	5.08E+06	-3.68E+04	0.00E+00	1.11E+04	4.22E+05
6.37E-02	8.29E+00	5.08E+06	-3.90E+04	0.00E+00	1.17E+04	4.21E+05
6.37E-02	8.16E+00	5.08E+06	-3.97E+04	0.00E+00	1.19E+04	4.20E+05
6.37E-02	8.51E+00	5.08E+06	-3.80E+04	0.00E+00	1.14E+04	4.21E+05
6.37E-02	9.33E+00	5.07E+06	-3.46E+04	0.00E+00	1.05E+04	4.21E+05
6.36E-02	9.80E+00	5.07E+06	-3.29E+04	0.00E+00	1.01E+04	4.22E+05
6.36E-02	1.04E+01	5.07E+06	-3.11E+04	0.00E+00	9.56E+03	4.22E+05
6.36E-02	1.08E+01	5.07E+06	-3.00E+04	0.00E+00	9.25E+03	4.22E+05
6.35E-02	1.05E+01	5.07E+06	-3.06E+04	0.00E+00	9.42E+03	4.21E+05
6.35E-02	1.05E+01	5.06E+06	-3.07E+04	0.00E+00	9.45E+03	4.20E+05
6.34E-02	9.79E+00	5.06E+06	-3.28E+04	0.00E+00	1.00E+04	4.19E+05
6.34E-02	8.76E+00	5.06E+06	-3.66E+04	0.00E+00	1.11E+04	4.17E+05
6.33E-02	8.40E+00	5.06E+06	-3.81E+04	0.00E+00	1.15E+04	4.16E+05
6.33E-02	7.12E+00	5.05E+06	-4.49E+04	0.00E+00	1.33E+04	4.14E+05
6.32E-02	5.61E+00	5.05E+06	-5.68E+04	0.00E+00	1.64E+04	4.11E+05
6.31E-02	5.76E+00	5.05E+06	-5.53E+04	0.00E+00	1.60E+04	4.11E+05
6.31E-02	5.35E+00	5.04E+06	-5.95E+04	0.00E+00	1.70E+04	4.09E+05
6.30E-02	5.24E+00	5.04E+06	-6.06E+04	0.00E+00	1.73E+04	4.08E+05
6.29E-02	4.05E+00	5.04E+06	-7.82E+04	0.00E+00	2.17E+04	4.05E+05
6.29E-02	3.03E+00	5.03E+06	-1.05E+05	0.00E+00	2.81E+04	4.01E+05
6.28E-02	2.34E+00	5.03E+06	-1.35E+05	0.00E+00	3.53E+04	3.98E+05
6.27E-02	1.54E+00	5.02E+06	-2.05E+05	0.00E+00	5.11E+04	3.94E+05
6.26E-02	1.29E+00	5.02E+06	-2.44E+05	0.00E+00	5.97E+04	3.92E+05
6.26E-02	5.79E-01	5.02E+06	-5.42E+05	0.00E+00	1.22E+05	3.84E+05
6.25E-02	2.39E-01	5.01E+06	-1.31E+06	0.00E+00	2.68E+05	3.77E+05
6.24E-02	4.21E-01	5.01E+06	-7.43E+05	0.00E+00	1.61E+05	3.80E+05
6.24E-02	2.18E-01	5.00E+06	-1.43E+06	0.00E+00	2.89E+05	3.75E+05
6.23E-02	6.33E-01	5.00E+06	-4.92E+05	0.00E+00	1.12E+05	3.82E+05
6.22E-02	1.04E+00	5.00E+06	-2.98E+05	0.00E+00	7.14E+04	3.85E+05
6.22E-02	1.03E+00	4.99E+06	-3.01E+05	0.00E+00	7.20E+04	3.85E+05
6.21E-02	2.09E+00	4.99E+06	-1.48E+05	0.00E+00	3.83E+04	3.90E+05

6.20E-02	2.40E+00	4.99E+06	-1.29E+05	0.00E+00	3.39E+04	3.90E+05
6.19E-02	2.42E+00	4.98E+06	-1.28E+05	0.00E+00	3.36E+04	3.90E+05
6.19E-02	1.90E+00	4.98E+06	-1.62E+05	0.00E+00	4.16E+04	3.87E+05
6.18E-02	2.12E+00	4.97E+06	-1.45E+05	0.00E+00	3.76E+04	3.87E+05
6.17E-02	2.05E+00	4.97E+06	-1.50E+05	0.00E+00	3.87E+04	3.86E+05
6.17E-02	2.08E+00	4.97E+06	-1.47E+05	0.00E+00	3.82E+04	3.86E+05
6.16E-02	1.51E+00	4.96E+06	-2.03E+05	0.00E+00	5.07E+04	3.83E+05
6.16E-02	1.57E+00	4.96E+06	-1.95E+05	0.00E+00	4.90E+04	3.82E+05
6.15E-02	1.53E+00	4.96E+06	-2.00E+05	0.00E+00	5.01E+04	3.82E+05
6.15E-02	2.76E+00	4.96E+06	-1.10E+05	0.00E+00	2.95E+04	3.86E+05
6.14E-02	2.69E+00	4.95E+06	-1.13E+05	0.00E+00	3.02E+04	3.86E+05
6.14E-02	3.20E+00	4.95E+06	-9.50E+04	0.00E+00	2.58E+04	3.87E+05
6.14E-02	3.21E+00	4.95E+06	-9.47E+04	0.00E+00	2.58E+04	3.86E+05
6.13E-02	3.23E+00	4.95E+06	-9.39E+04	0.00E+00	2.56E+04	3.86E+05
6.13E-02	3.37E+00	4.95E+06	-9.00E+04	0.00E+00	2.46E+04	3.86E+05
6.13E-02	3.43E+00	4.94E+06	-8.82E+04	0.00E+00	2.42E+04	3.86E+05
6.12E-02	3.16E+00	4.94E+06	-9.58E+04	0.00E+00	2.60E+04	3.85E+05
6.12E-02	3.03E+00	4.94E+06	-1.00E+05	0.00E+00	2.70E+04	3.84E+05
6.12E-02	3.27E+00	4.94E+06	-9.25E+04	0.00E+00	2.52E+04	3.85E+05
6.12E-02	2.93E+00	4.94E+06	-1.03E+05	0.00E+00	2.78E+04	3.84E+05
6.12E-02	2.31E+00	4.94E+06	-1.31E+05	0.00E+00	3.43E+04	3.81E+05
6.12E-02	1.66E+00	4.94E+06	-1.81E+05	0.00E+00	4.59E+04	3.78E+05
6.11E-02	1.09E+00	4.94E+06	-2.77E+05	0.00E+00	6.68E+04	3.75E+05
6.11E-02	7.39E-01	4.93E+06	-4.08E+05	0.00E+00	9.45E+04	3.71E+05
6.11E-02	1.51E-01	4.93E+06	-2.00E+06	0.00E+00	3.89E+05	3.60E+05