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Products Liability Law

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Abstract

This Interactive Qualifying Project, Products Liability, focused on the legal aspects of engineering. We were given two literary sources: An Engineer in the Courtroom and Products Liability in a Nutshell, which provided us with a basic legal foundation in products liability litigation. The knowledge of this material was used to investigate and analyze three cases. Our analysis of these cases was based upon our newly formed legal foundation and present knowledge as engineering students. In the end, we had to determine what happened and who was or was not liable in each of the three products liability cases.

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1 The Art of Advocacy Skills in Action

1.1 Attractive Nuisance

This video titled, "Attractive Nuisance", contains two case studies. The first case study presented in this video is Kelly vs. Admiral Reality. The second case involves a Child Pedestrian Knockdown case. The two major issues that these cases focus on are (1) attractive nuisance and (2) the opening statement involved in a legal trial.

Before we begin discussion on the two case studies, it is important to define what exactly an attractive nuisance is. A nuisance, in law, can be defined as the use of property or course of conduct that interferes with the rights of others by causing damage, inconvenience, or annoyance. In the first case, Kelly vs. Admiral Reality, the plaintiff, Katherine Kelly, is filing a lawsuit against Admiral Reality, claiming that Admiral Reality's gravel pit is an attractive nuisance, and is responsible for her son Christopher's death. The plaintiff's lawyer in this case is Leonard Decof.

This case begins with an opening statement by the plaintiff's lawyer. The purpose of the opening statement is for the plaintiff's lawyer to make the first opening address to the jury, which consists of a statement of what the plaintiff or the prosecution intends to prove. The defendant's attorney then makes an opening address to the jury, which consists of a similar statement as to what proof will be adduced on behalf of the defendant. In a number of jurisdictions, the opening address on behalf of the defendant is not made until the prosecution has completed its part of the case.

In Kelly vs. Admiral Reality, the narrator gives a number of recommendations on how a lawyer should conduct his opening statement to the court, specifically the judge and jury. First and foremost, the narrator suggests that the plaintiff should not use overly aggressive argumentative statements when addressing the jury for the first time.

Instead, the narrator lists four qualities/characteristics that lawyers should use when giving opening statements. These qualities are:

(1) Be trite

(2) Be apologetic

(3) Be tentative, i.e. "I think, hope or may be…" and,

(4) Be unimaginative

Now that we have discussed the major issues (attractive nuisance, opening statements) of the video, it would be appropriate to give a description of the Kelly vs. Admiral Reality case. As mentioned earlier, the plaintiff is Katherine Kelly. The victim is Katherine's son, 8-year old Christopher Kelly. The lawyer for the plaintiff is Leonard Decof. The defendant in this case is Admiral Reality. During this case, Decof gives a soft-spoken description of the events that occurred on the day of young Christopher's death. On the day in question, Christopher, and his two friends, Bobby and Ritchie, were playing in the Admiral gravel pit near the Admiral shopping Plaza. The boys were being boys, horsing around playing games like "King of the Mountain." However, one of the banks in the gavel pit collapsed, covering young Bobby and killing him.

The defense's main arguments in this case are (1) the boys should not have been trespassing and (2) evidence from testimony (given by Bobby's friend Chris) stating that Bobby's friends warned him that the bank he was on was unsafe.

Now that we have a description on the case, we will present some of the crucial points and issues involved in this case. The first crucial point is, who has ownership of the land? Should Admiral Reality be in court or should DiLerinzo Construction, the company that leases its gravel pit property to Admiral Reality? The second crucial point in this case is that evidence presented shows that Admiral Reality knew children were on the land that they leased from DiLerinzo Construction. So why did Admiral Reality not put up a fence or take some type of deterrent action to prevent young children from entering the gravel pit, which is an attractive nuisance?

There are two main issues that the plaintiff's lawyer intended to establish in this case. The first issue was that of liability and damages. Who will take responsibility for Bobby Kelly's death? And who will liable for the damages (pain and suffering) brought upon his family? The second issue that the plaintiff's lawyer presents is that his plaintiff does not want money to ease the pain and suffering of her son's death. Instead, she wants Admiral Reality to make its area safe, so that it is not an attractive nuisance.

As mentioned earlier, there are two cases presented in this video. The second case is a Child Pedestrian Knockdown Case. In this case, the plaintiff's lawyer, Bill Colston, attempts to establish the events that left his client, young Steven, with retrograde amnesia, as a result of being hit by a cement truck. Basically, this case is another attractive nuisance case where a cement truck hits Steven, the victim, as he attempts to cross a dirt road. Once again, the plaintiff's lawyer will try to establish attractive nuisance, claiming that there was nothing to deter Steven from the defendant's property.

The key events in this case are:

(1) Ownership of the truck and,

(2) Did the driver of the cement truck take an evasive action to prevent the accident?

Bill Colston also brings up the issue of whether or not the driver was speeding. However, in the defense's favor, there is a witness who testifies that Bobby turned his head to look backwards (temporarily distracted) as he crossed the road.

1.2 Direct Examination

This video discusses an important process found in litigation, direct litigation. The video explains that in order to be a good attorney you must be successful in your direct examination. In order to convince the jury an attorney must do several things. The attorney's primary task is to keep the jury's attention. It is important to keep things brief, because jurors tend to have short attention spans. Also attorneys should always start the examination with something important and end with something important. This process will catch the juror's attention from the start and will leave the juror in suspense.

Leonard Decof is the prosecuting attorney in the first case. It deals with the direct examination of an economist to establish loss of future earning. The video goes through the steps involved in a case dealing with the loss of future earnings. The first necessary step is to put a creditable economist on the stand. In order to build the economist's creditability, the attorney must discuss his/her education, professionalism, and working experience. After this has been established, the jury feels more comfortable with the witness and is able to believe him fully.

The other case deals with the direct examination of a plaintiff in the workplace. The case talks about a worker at a local jewelry plating company, whose hand got caught in the machine. During cases such as these, attorneys need to follow various steps. First of all, the attorney needs to me more passive during the direct examination. The attorney must also use visuals effectively. In this specific case it was important for the attorney to show that the operator knew how to operate the machine. It is also essential to establish the fact that the worker was paying attention; hence it is important for crisp answers. Lastly it is important to show the jury what was lost and its importance. In this specific case Linda lost the use of her hand. For example she is now unable to tie her shoes or carry on with her normal life.

1.3 Opening Statement in a Construction Site Injury Case, Opening Statement in a Product Municipal Liability Case

As the title of video three suggests, the following cases will present the use of opening statements during trial.

In the first case, a Construction Site Injury, Leonard Decof, the plaintiff's lawyer, gives an opening statement. In this opening statement, Decof tries to seek identity with the jury, by suggesting him and the jury work as a "team" during this trial. The plaintiff is Al Duke, a construction worker. The plaintiff in this case is trying to seek restitution for his amputated leg, which was the result of a construction site injury.

The date on which the plaintiff was injured was July 25, 1979. On this day, Al Duke, an ironworker, was working on St. Mary's school. Duke had been working on this project for the past two months. On the day in question, Al Duke had to move angle irons (90 degree steel segments that are 20 ft long) up to the fourth floor on the building under construction. However, these angle irons are too heavy to be moved by hand. Instead a hoist would have to be used to move the pieces of iron.

So what are the facts of the case? The Wilson Company leased the hoist used to move these angle irons to Arvard Construction. The manufacturer of the hoist is the Anston Company. According to the manufacturer, the hoist can safely lift a load of no more than 2500 lbs. Lastly, Leonard Decof gives a more detailed description of this particular hoist and its operation in the video.

On the day of the accident, the hoist was lifting a load of approximately 2000 lbs. This load consisted of three men and a number of angle irons. One of men on the platform's hoist was Al Duke. These men had to ride with the load to help balance the angle irons. Also, it would be easier for the men to unload the angle irons and save them time, since they would not have to climb up four floors. The operator of the lift was Mr. Stearns. The accident occurs when the hoist was in midair/operation. At this time, the hoist's operator loses control of the machine (possibly due to mechanical failure) and the hoist's load falls to the ground, falling on Al Duke's leg. Eventually this injury will cause Duke to be hospitalized for months. During this time he develops gangrene in his left leg. To prevent death, Duke's leg is amputated.

Decof makes it clear in his opening statement that the defense will give the jury a number of reasons why they should not be liable for Al Duke's injuries. The first reason being that the hoist was not meant for passengers. The defense will tell the jury that there is a warning right on the hoist. However, Decof also informs the jury the warning label for "no passengers" is located in an inconspicuous area on the machine. Decof claims that the defense will also suggest that the hoist operator, Mr. Stearns, was not completely knowledgeable of how to operate the hoist. For example, if Mr. Stearns had just let go of the controls, the hoist's clutch would have locked in midair, preventing a collision of the load and the ground. If Mr. Stearns had knowledge of the hoist, he would have known that there is a built-in safeguard that locks the clutch in place if the operator lets go of the controls. This safeguard was designed in case an operator had a heart attack and could not momentarily operate the hoist. In other words, if Mr. Stearns had let go of the controls, there would have been no accident.

As a result of the accident, there have been a number of changes in Al Duke's life. For example, Duke no longer has a leg and can no longer work construction, a job that he loves. Instead, he works as a ticket taker at a local movie theater. There are also a number of important issues in this case. Because of the defendant's negligence, a man lost his leg and his job. Now, the issue of liability plays a role in this case. Who should be liable for a faulty hoist design or negligent entrustment? These are issues that the plaintiff's lawyer needs to make strong and convincing arguments for. The last issue presented in this case is how to compensate Duke for his losses. To do this, Decof constructs of formula that consist of three elements. These elements are:

(1) Payment of hospital bills,

(2) Payment for wages and worked missed while Duke was hospitalized, and

(3) Payment to ease pain and suffering.

Decof feels that this formula is highly objective. However, the defense may strongly disagree.

As mentioned earlier, the second case in this video deals with the Opening Statement in a Product Municipal Liability case. This case involves a defective baseball-pitching machine that injures eleven-year-old Charles. Once again, the plaintiff's lawyer is Bill Colston.

In this case, Charles, the plaintiff, is playing around an unattended pitching machine. Charles accidentally bumps into the machine and the iron swing arm (spring loaded) hits him in the head. As a result of this accident, parts of his skull are fragmented into his brain. Neurosurgery is needed to repair the injury. Colston, the plaintiff's lawyer, presents Charles as being young and innocent. In a way, Colston builds up Charles as the protagonist in this case.

Colston mentions in his case that research has found that similar accidents have occurred, where the machine's arm is sprung forward even when the machine is off. He also mentions that the government knew of the machine's history of accidents, but took little action to correct the problem. The manufacturer of the pitching machine also knew of its machine's flaws. To prevent future accidents, the manufacturer developed a guard for the iron spring-loaded arm. This guard sells for $45.00, and is not a standard item on the machine at the time of sale. Colston mentions that by not making the guard standard, not all consumers will know of such guard, especially if they do not keep in close contact with their distributor. He also argues that the guard should be standard on the baseball-pitching machine.

As a result of Charles's neurosurgery, a metal plate was inserted in his head. Because brain tissue was damaged, Charles lost his sense of feeling on the left side of his body. Also, Charles needs physical therapy on a regular basis to help aid the healing process. He will most likely need physical therapy for the rest of his natural life. The injury severely affected this young man's life. After the accident, Charles did not do as well in school, he had difficult learning and his IQ dropped. For these reasons, he dropped out of school.

The case concludes with an economist's recommendations of how much money should be awarded to Charles to pay for his medical bills and the fact that he needs to be cared for (medically) the rest of his life. Colston makes it a point to elaborate on the fact that Charles's life will never be the same again as a result of injuries he suffered.

1.4 Cross Examination of Non-Medical Experts

The first case deals with the cross examination of a civil engineer in a Premises Liability. It talks about a woman who falls on a sidewalk. She is injured and is attempting to hold the design of the sidewalk accountable for her situation. Miller, the attorney on the case, immediately shows the importance of controlling the witness. Controlling the pace of the trial can also help aid your trial. An attorney can do this by amplifying, modifying, and destroying the testimony of the witness. You must present contradictory information against the witness. Use depositions like: Is that the truth? Did you say that? Did I read this correctly?

The second case discusses the cross examination of an accident reconstruction expert in a vehicular collision case. It's about a truck involved in an accident. Attorney Robert Conason attacks with his own repetitive style of questioning. Several other strategies are discussed. The first is an attack on the professional conduct of the witness. Or when you have an evasive witness, simple questions should be used in questioning, statements, and utilize expert to draw points that support your theory. Use leading questions rather than open ending questions and a few pithy questions to prove a point.

1.5 Cross Examination of an Agricultural Design Expert in a Farm Machinery Case, Cross Examination of Electrical Engineer in an Electrocution Death Case

In this video, two cases are presented using the technique of cross-examination. As a lawyer, it is vital to have good eye contact and use of the "leading question" when cross-examining a witness. Also, it is up to the lawyer to control the pace of questioning.

As the title of the video suggests, the first case involves the Cross Examination of an Agricultural Design Expert in a Farm Machinery Case. In this particular case, an expert (engineer) for the John's Company testifies on his company's behalf that their product, a combine, was not responsible (liable) for the plaintiff's injuries. Throughout this cross-examination, the plaintiff's lawyer, Robert L. Habush, refers to the expert's deposition. By referring back to the deposition, the plaintiff's lawyer tries to see if the witness will contradict his earlier testimony. We are told by Habush that the expert witness has testified over a dozen times in the past for the John's Company.

Besides trying to make the expert witness contradict himself. Habush attempts to prove that the expert is biased towards farmers. He does so in the following manner: first, Habush shows the witness and the jury that the manual for the combine, produced by the John's Company, states that 1/3 of all farm accidents are caused by the farmer. However, Habush shows a magazine article written by the expert, where he states that farmers themselves cause the majority of farm accidents (certainly more than 1/3). This helps Habush establish the expert as being biased towards farmers.

After this attempt to prove the expert's bias, Habush has the expert explain what happens when a combine becomes "clogged." Basically, a combine because "clogged" when field conditions are less than desirable, i.e. the field is wet. To compensate for a wet field, a farmer needs to adjust the pulley system on the combine. This should prevent "clogging." However, this is a dangerous procedure since the farmer needs to put his hand near the components of the engine. In this particular case, the plaintiff tried to adjust the engine's pulley to prevent clogging. In the process, the pulley was activated and the plaintiff's hand was torn off.

Habush now interrogates the expert's examination/report of the combine after the accident. After a series of questions, it is obvious that the expert has no notes, photographs or documentation on the accident. This severely affects his credibility as an expert witness. The expert claims that the accident happened because of the farmer's negligence in making sure the pulley lever was pushed forward. He also claims that the lever may have been out of adjustment. However, the expert's claims are hard to prove without any photographs or documentation. Lastly, Habush makes it a point to mention that in 1959, 4 years after the first combine was produced, the John's Company in fact made a pulley guard. However, he questions why the John's Company did not make this guard standard on all its combines to prevent future accidents.

The second case presented in this video is the <u>Cross Examination of an Electrical Engineer in an Electrocution Death</u> Case. In this case, the plaintiff's lawyer, J.D Lee, has an electrical engineer, Mr. Geiger, give his expert opinion on who is liable for the electrocution death of J.W. Odium, a painter. On the day of the incident, Odium was painting on Transformer Block #5. Odium lost his balance while painting and came into contact with a live electrical line. As a result of his accident, he was electrocuted and killed. The expert witness states that Odium should not have been painting on the transformer block. According to National Electric Standards Code (NESC), only qualified persons should be within 2ft of live wires. Odium was not qualified. Therefore, the power should have been shut off, or Odium should not have been on Transformer Block #5. According to the NESC, only the system's operator knew the proper clearance.

In addition to this, J.D. Lee and Mr. Geiger both agree that Odium did not have the proper diagrams to shut off the power. Later, J.D. informs the court that even if Odium wanted to shut off the power on his own he could not, because Acme Aluminum Company locked the area where the power switches were located. Lastly, Mr. Geiger suggests that it was the responsibility of the painter to inform the Acme Aluminum Company that the power needed to be shut off.

1.6 Preparing for A Disposition in A Business Case by Matthew Bender

By definition, a disposition is a settlement of a business or legal matter. Generally, dispositions look like informal meetings around a business table. During dispositions, you, your lawyer, opposing lawyer and a court clerk are present. There are no judges present, but you are under oath and must tell the truth.

The first case presented in this video deals with the disposition of a CEO of a major industrial company. The opposing lawyer represents Corrosive Chemicals, a company who does not want to be bought out. The main point that Matthew Bender makes in this first case is never volunteer unnecessary information. Bender then lists nine mistakes made by the witness in this first disposition. The mistakes he makes are:

(1) Identifies a major player
(2) Raises a sensitive issue
(3) Mentions a player by name
(4) Discloses an important document
(5) Names another player
(6) Discloses another document
(7) Highlights importance of document
(8) Identifies another player
(9) Discloses privileged information

The witness also mentions Dick Johnson, an investment banker and Bill Morgan, the head of the audit committee. Once you volunteer information, you have to answer the new line of questioning by the opposing lawyer. In other words, do not bring up unnecessary information. Also, good witnesses answer only what is asked. For example, when the same case is presented again with a good witness, you notice the difficulty the opposing lawyer has trying to obtain information. This witness gave short answers and told the opposing lawyer that his company wanted to buy Corrosive Chemicals because the stock was low in the Wall Street Journal. According to the video, as a good witness, you should:

- Listen to the question
- Pause before you answer
- Keep your answers short
- Never volunteer information, and
- Be careful of tricky questions.

Be a careful witness. Pause after the question is asked. This will give your lawyer time to object if he/she feels the question is unfair. Also, if you do not understand the question, ask for a "clearer" question.

The next case on dispositions involves a market research company. The main point in this case is to avoid tricky questions. You can avoid tricky questions by:

- Listening to the question
- Pausing before you answer
- Giving your lawyer time to object, and
- Asking for a clearer, fairer question

The next case disposition involves a movie studio being sued by investors. The point in this case is "when in doubt, ask." In this case, the witness changes his story from the disposition to trial because he did not understand the line of questioning during the disposition. The witness could have avoided this situation by:

- Asking his lawyer for advice in advance
- Asking the other lawyer for clearer questions
- Asking your lawyer for advice and guidance, and
- Being honest (Do not be afraid to say, "I don't know.")

The last case presented in this video deals with the disposition of a chief engineer for a small engineering firm. The main point in this case is that if you do not remember information, do not attempt to guess and make up false information. This will only lead to problems and discredit your earlier disposition. In this case, the witness is unsure of the date of a meeting in his disposition. Later on the trial, the witness is proven wrong about the date he guessed. This severely ruined his reputation.

In conclusion, we learned:

- Answer only the question put to you
- Keep your answers short and direct
- Listen to the question
- Ask the other lawyer for a clearer, fairer question
- Ask your lawyer for guidance or advice
- Always be honest
- If you do not know or do not remember, say so, and
- Always pause before you answer. This helps you think and remain calm

1.7 The Conclusion

The conclusion should consist of five or six statements at the end of the closing arguments. The conclusion should be used to wrap up the entire case, put into the light the lawyer speaking wishes to have the jury see under it. Alienation is a popular way in which the lawyer concludes. By using alienation, the lawyer attempts to create even more sympathy with the jury.

The conclusion should be a prepared statement, since there are three parts that should be expressed during this. The manner or method in which these parts are delivered can determine the outcome of the lawyer's case. The first part involves how the lawyer will deliver the story to the jury. The second part involves the lawyer bringing forth the actual importance of the jury to their faces. Letting the jury know that what they decide could affect the plaintiff for the rest of his/her life, makes the decision for the jury even more serious.

There is no structured style in the way a lawyer presents his/her closing arguments. Whatever form of delivery a lawyer chooses depends on the style that works best for them, and sometimes they incorporate new techniques they learn from other lawyers while in the courtroom. As a rule of thumb, it is best to apply only those techniques that can easily be integrated into the lawyer's own form of delivery.

1.8 Summation in a Multiple Amputation Case – Robert E. Cartwright

The summation in a trial is the closing statement of the trial. As the narrator, James W. Jeans, suggests the lawyer has to make his closing argument say "interesting things interestingly." By the time of summation, the lawyer should have already established a relationship with the jury and court. The summation should be primarily based upon the principle of argumentation. The narrator makes special mention of the two unique aspects of the summation process, which are:

(1) This is the time when you better acquaint yourself with the jury, and

(2) This is the time in the trial with the most suspense, fright, and entertainment

In this particular case, the plaintiff's lawyer, Robert E. Cartwright, is representing 28-year-old Frank Lee, a forklift operator. As a result of the accident, Lee had to have an arm and leg amputated. Cartwright argues that the defendant, the manufacturer of the forklift, should be liable for the injuries. Cartwright also claims that the accident could have been prevented if the manufacturer had simply installed a $50 rollover protection (ROPS) device. During his summation, the lawyer makes it clear that the manufacturer has certain responsibilities to their products. These responsibilities should also take into consideration the expectations of consumers. In this case, Cartwright argues that the defendant failed its responsibilities and expectations to its consumers.

Another important point that the narrator mentions is the fact that Cartwright did not use a podium during his closing argument. Jeans believes that a podium makes the speaker seem like he is an authoritative figure, the podium being the barrier between the speaker and his audience. With no podium, there is a certain "openness" perceived about the speaker. The narrator also suggests the use of visual aides during summations. Visual aides are especially useful when explaining financials involved in a case. These aides could be either in the form of printed graphs, or simply free-hand drawings on a chalkboard. Either way they help "paint" a picture in the jurors' minds.

Robert E. Cartwright also uses a good technique of establishing credibility with the jury by not asking "for a dime" for nursing services. Cartwright leaves it up to the jury to decide how much money should be awarded for nursing services. During the summation, Cartwright also makes mention that Frank, his client, can no longer enjoy activities such as fishing, hunting and bowling.

Lastly, Cartwright claims that his plaintiff should be compensated for his physiological injuries. He lists three methods/procedures to convert human pain to monetary value, they are:

(1) Lump-sum method

(2) By "guess and golly", and

(3) Scientific method

1.9 60 Minutes II: A Classic Cover-up?

This video is a segment from the television program "60 Minutes." The video is about the faulty design in the "drop in" gas tanks installed in 1964-1970 Ford Mustangs. This faulty design has resulted in numerous deaths in the past 35 years. The first actual case presented in this video involves Harold Delow, a teen who is killed in an accident when his 1966 Mustang hydroplaned and was struck from the rear by another motorist. The rear impact caused the car to explode, killing Harold instantly. A number of other similar accidents, involving the victims are presented, but the main argument concentrates on the case of Harold Delow.

The problem with the 1964-1970 Mustang is its "drop in" gas tank. With this type of design, the top of the gas tank is the floor of the trunk. When hit from behind, there is no protective barrier, except for a rear seat, to prevent gasoline from spreading to the passengers. In most cases, this gasoline is ignited (in the passenger area) and the passengers are severely burned or even killed. Ford claims that there is no faulty design in the gas tank, but rather the majority of the accidents were caused by excessive speed. Ford also insists that the design is suitable since there are still 1.5 million 1964-1970 Mustangs on the road today.

There are also two interesting interviews in this video, concerning Peter Burtleson, a former Ford engineer and Lee Iacocca, the President of the Ford Motor Company. Burtleson claims that the drop in gas tank was indeed a poor design. Iacocca informs us that the safety requirements today are much more strict than they were 35 years ago. Back in the 1960s, "style sold cars, not safety." Iacocca is secretly taped having a conversation with former President Nixon saying that, "safety was ruining the automobile industry."

The most damaging evidence presented by Harold's attorney is the case of Crash Test 301 by Ford Motor Company engineers. In this test, a rear collision occurs, rupturing the Mustang's gas tank, spraying gasoline on the test dummies. However, Ford claims that the objective of this test was to evaluate occupant movement. Therefore, they did not see any reason in submitting the video to the DOT. Crash Test 301 was not obtained by the DOT until 1976.

It is also interesting to note that according to a report in the video, the Ford Mustangs (1964-1970) mortality rate of deaths by fire was three times higher than that of other vehicles from the same period. Lastly, Lee Iacocca is quoted, "if you want safety, buy a new car." This only adds more to the opposing side's argument concerning the liability of the Mustang's (1964-1970) gas tank.

2 An Engineer in the Courtroom

By William J. Lux

2.1 Introduction

Chapter 1 explains what subjects an engineer might encounter in a matter of litigation. Throughout the book, the author, William J. Lux, attempts to explain the obligation an engineer has to the workplace, as well as society. The author stresses, that during the planning and development of a product, the engineer must consider the possible claims for injury or loss that may be brought against his product. In addition to this, William J. Lux informs us that the purpose of this book is not to criticize the legal system, but instead tell engineers something about the legal system and how it works. Also, Lux states that the book will explain how an engineer should conduct himself in and out of the courtroom when defending a product.

The chapter goes on to tell us that the majority of the cases in this book will deal with earthmoving and construction machinery. Next, the author gives the reader a short history of the development of the legal system. He explains that the development of law was based primarily on two principles: (1) rights and (2) responsibilities. Today's body of law (in the United States) has been developed to express the general welfare of all the personal freedoms of individuals to be irreversibly related. In the United States, our body of law is the Constitution. In the Constitution, interpretations and agreements are difficult to obtain in a single, concise statement that has universal application. For this reason a legal or court system is set up to resolve situations in which two entities do not or cannot agree.

2.2 The Nature of Accidents

The majority of lawsuits concerning products are generally termed accidents. In accidents, someone has suffered injuries or losses, and they seek redress for those losses through litigation. Problems such as products liability litigation (most frequent form of activity), business matters, patent conflicts, and family disputes often get the engineer involved in the courtroom. For this reason, the majority of discussions in this book deal mainly with the products liability actions. In this chapter, the focus is on "accidents." The author goes into the discussion about the numerous definitions of the word "accident." In short, the word "accident" has various meanings. However, for the purpose of this book the author defines "accident" as:

- An occurrence that is unexpected, and
- An occurrence that causes loss or injury, which can be expressed in some form of economic terms.

These two conditions will be the character and substance of the term "accident" as it is presented in the text.

When an accident involves a product, the product and its manufacturer and seller are likely targets for claims for recovering damages or losses. This is when the engineer becomes involved in the situation. The engineer is typically in the position to defend the product and to explain the benefits of the design.

Litigation claims are directly related to accidents involving products. Litigation claims offer a proposed feature or design detail, which, if it were in place at the time of the accident, would have prevented the accident. The author then goes on to provide two examples of litigation claims involving: (1) a worker who is hit by an earthmoving scraper moving in reverse and (2) a maintenance man who was injured in a fall from the deck of a loader while he was fueling it.

After this discussion of litigation claims, Lux goes on to give explanations and descriptions of accident types. In general, his sixteen sub-classifications of accidents are based on experience with earthmoving and construction machinery. The sixteen types of accidents presented in this chapter are:

1 Collision – two bodies trying to occupy the same space.
2 Slip and Fall Accidents – occurrences where the victim of the accident is not involved with anything else but the surface, location, or conditions upon which he is moving.
3 Loss of Control – occurs when a person loses control over his machine under his responsibility.
4 Hit by Falling Object – includes all situations where the person or machine is hit by a falling object.
5 Suffocation – when a person is deprived of oxygen.

6 Electrocution – electric shock that may interrupt normal body functions such as breathing and heart action.

7 Poisoning – includes the ingestion or contact with substances which injure or destroy any part of the body or its functions.

8 Shock and Vibration – the effect of sudden changes in forces acting upon the human body that may cause injury.

9 Entanglement – happens when a person gets some part of his body, clothing, or equipment too close to a moving part of a machine.

10 Cuts and Abrasions – one may get cuts, abrasions, or other similar injuries from contact with a machine. Cuts and abrasions result from partial involvement, touching a surface or an edge just briefly.

11 Fire – combustion of any sort. Fire accidents include suffocation; smoke inhalation, property damage, personal injury and/or death.

12 Mechanical Failure – in the man/machine relationship, it is possible for a machine to fail and lead to an accident with no expectation or participation of the people involved, either controlling the activity or affected by the failure.

13 Struck by Moving Projectile – includes being hit by almost anything flying through the air.

14 Natural or Environmental Factors – includes earthquakes, tornadoes, cyclones, floods, and other natural and environmental events.

15 Homicide – the killing of a person. This also includes activities where death is the objective and expected result. Homicides may also be accidental.

16 Other Accidents – those accidents, which have no proper place in the scheme of things.

The text then goes on to provide eighteen examples of what can be properly called "accidents". The chapter concludes by restating the obvious: that accidents are unintentional and cause injury or economic loss. Lastly, the author mentions that the list of classifications of accidents is not meant to be used by all professionals, i.e. medical professionals may have their own classifications of accidents.

2.3 Why Go To Court?

The purpose of this chapter is to provide reasons why people go to court. Before we go into discussion of the reasons why people go to court, we must discuss the importance of the litigation process. The sum and substance of the litigation process is the right of the citizen or other entity to seek redress for damages in a court of law. The litigation system (filing suit, naming claims, and eventually arriving at a settlement or going to trial before a judge) is the process we use to settle disputes.

Now that we have a background on the litigation process, the author goes on to discuss why we go to court. In a perfect society there would be no need for court because there would be no disagreements and everyone would be satisfied with the status quo. However, in the real world there are two problems:

(1) Our society is not perfect – the life of a society is grounded in its effort to get better.

(2) Individuals who make up the organization of society are not perfect – individuals respond in different ways to differing environments and situations into which they are placed.

This mixture of different people and viewpoints is necessary for society to function. Without differences and disagreements, there would be no need for change or improvement. Also, there would be no need for inventions or the creation of new ideas.

We invent in order to change the world. There are numerous reasons to invent, i.e. to relieve pain and discomfort. The author then mentions that whether an idea or invention turns out to be good or evil depends on the use to which it is placed. However, whether a product or invention becomes good or evil depends to a great degree upon how society and individuals within a society decide to use the product. An example of this would be a knife. A knife, designed to cut meat or bread could also be used to kill another person. Responsibility lies with the one who improperly uses the knife.

An interesting example of "proximate cause" is now presented in the chapter. "Proximate cause" is the legal definition of who or what is the root cause of an injury or loss. The example of proximate cause, presented in the text, includes a negligent motorist, who under the influence of alcohol, veered off a highway and killed a 14-year old boy upon impact. There were several causes of the death, which include:

- The driver was negligent,
- He violated the liquor law, and
- The person who sold him the liquor might have done so illegally.

An attorney might even go as far as to argue that another cause of the accident would be a lack of safety devices provided by the automobile manufacturer. This may have prevented the intoxicated person from starting their vehicle.

Another example of proximate cause is presented in a claim against the manufacturer of a crawler dozer. In this case, the plaintiff was injured because he removed the ROPS (roll over protection systems, or roll bars) from his tractor and suffered severe head injuries. The plaintiff claims that if the ROPS were welded on to the tractor frame instead of being bolted on, he could not have removed the roll bars and would not have been injured. Therefore, the defect (of being able to unbolt the roll bars) was cited as the proximate cause of the injury.

After presenting these two cases, the author mentions an interesting point: Should we stop inventing products because people improperly use them in a way that may cause injury? The answer is no. Instead, the United States has adopted a legal system to urge and encourage the good and proper use of products and power.

The author then describes what a legal system is. The legal system includes a body of laws that have been enacted by a legislature. Those laws are enforced by an administrative system. The judicial system is established to determine whether the accused lawbreaker is guilty or innocent of the matter of which he/she is accused. The civil court system most often becomes the site of dispute resolution in which the engineer may be involved.

So how does the product you invented get you called into the courtroom? The answer is: an infinite number of reasons. The most obvious being that someone (the plaintiff) believes that his relationship with your product or design has been "unbalanced". To protect the engineer, a set of legal requirements for products has been adopted. These requirements are as follows:

- The product must meet the expectations of the buyer and user.
- The product must not be unreasonably dangerous.
- The product must not be defective.
- The product must warn of hidden or unexpected dangers.
- The product must be manufactured according to specifications.
- The product must not be misrepresented.
- Proper instructions for safe use and operation must accompany the product.

Other conditions apply to the user, such as:

- He must use the product according to instructions and warnings.
- He must not misuse the product.
- He must maintain, repair, and inspect the product according to instructions.

All of these conditions listed above are potentially arguments in a situation where an accident, injury, or loss has occurred. The conflict of the claim and the response leads to lawsuits and attendant activities.

The next issue of importance in this chapter is "strict liability". Before strict liability, the plaintiff had to show negligence, carelessness, or even intent of some kind in order to receive compensation for their damages. However, in the past 30 years, courtroom decisions have developed the doctrine of strict liability as sufficient to prove their case, even if the defendants did not know the so-called "defect" was there. A related legal doctrine in defense of the strict liability theory states:

- The cost of the accident should be accessed to those who could have prevented or avoided the accident. Those, the court seems to believe, are the designer and manufacturer.
- The cost of the accident should be accessed to those most able to pay those costs.

Lastly, the chapter concludes with two reasons why an engineer may lose a court case. They are:

- Under the guidelines of the law, your product is indeed defective – that is, you can do and should have done something more to prevent such accidents, or
- You did not tell your story well enough in court and you did not convince the jury.

2.4 Avoiding Litigation

This chapter begins by stating the obvious in avoiding litigation: do not have any accidents involving your product or machine, or with the service you provide. This section of the book lists precautions that engineers can take to avoid accidents and litigation. The author lists six of these precautions that an engineer should implement when designing a product. These precautions are:

(1) Avoid the accident – for the engineer, this means to eliminate the hazard in design. For the user this means to avoid the accident condition, or to take steps to move safely through the potential accident situation.

(2) Protect from the accident – if an accident cannot be eliminated for some reason, protect from it. Use shields or some other means to protect people form potential accident. Users may do this by keeping away from the worksite. Designers do this by designing the hazard so that the person cannot reach it during normal operation.

(3) Make the accident safe – design the machine in such a way that even if the accident actions happen, no injury results. An example of this would be ROPS on construction machinery.

(4) Warn of an impeding accident – a further method to protect against accidents is to warn of an impeding accident. For example, such a warning is the stall warning on an airplane. However, use warnings of impeding accidents sparingly and carefully, lest you tire and confuse the operator with buzzers and lights. Further, the warning of a condition, which comes too late, is also useless.

(5) Warn of the possibility of an accident – in this level of defense against accidents, the operator or worker is informed that a hazardous condition can exist under certain circumstances. By instructions or warning decals, the person is made

aware of the condition that may lead to an accident, and an attempt is made to precondition him to take the right action should those conditions occur. It should be noted that these types of warnings are usually considered the last line of defense for accidents. If you warn, you may protect yourself to some degree in an accident lawsuit, but you have not eliminated the accident.

(6) Protect the operator (or other personnel) from the accident if it should happen – the philosophy here is that, if an accident cannot be avoided, then protect the operator. That is a legitimate objective of engineering effort. Engineers should use the philosophy of eliminate, protect, warn, and train as a hierarchy of attack against litigation.

The chapter now goes on to present Dr. James O'Toole's discussion on the progress of a civilized society as a dynamic process dealing with four concepts – liberty, freedom, merit rewards, and security. He shows how a balance must be maintained between all of those factors or desires. He leaves the strong impression that a successful society works to provide all of those factors, and does not simply trade off one for the other. Neither does it concentrate on one and ignore the others. In the same way, efficiency and quality of life appear to be characteristics that pull against each other. High efficiency tends to require some reduction in the quality of life.

Lux then goes on to discuss what are generally considered to be the objectives of designing a product or machine. They are:

- Specifications – the physical size, power, and other measurable details of the product
- Performance – the work the product is to do and the rate at which it will do that work
- Life – how long the machine will last or continue to work
- Reliability – how dependable the machine will be or how often it will break down
- Serviceability – how long it will take to do both the routine, scheduled service and maintenance and the unexpected repairs
- Costs – the cost to produce the machine, an important and basic concern to the designer; and the operation and maintenance costs of importance to the user

- Safety – how safe is the product, and what hazards does it present?

Next, the topic of *avoiding accidents through engineering consideration* is presented. The six individual approaches are:

(1) Specifications and Objective Targets – the specifications for the product to be designed and the objectives for that product should include specific references to safety along with references to the other design objectives.
(2) Design to those objectives, including safety goals – design the product to meet the objective targets, incorporating the necessary safety goals.
(3) Failure mode-and-effect analysis – the analysis involves listing the foreseeable failure modes of both the product and the person properly using it. Then the analysis follows a consideration of the effects that each of the failure modes will have on the machine, the operator and people around it.
(4) Accident probability/effect/severity studies – first, what is the statistical probability of the incident happening? Second: What is the effect of the incident on the machine and operator, or the bystander, if the incident occurs? Finally, the engineer considers the severity of the injury should the incident occur.
(5) Audit the design – for test and evaluation people to independently repeat the design thinking.
(6) Simulate failures, which might lead to accidents – simulate or cause actual failures that might lead to accidents.

After haven done all this, the designer and test engineer may consider methods of predicting when failures are likely to occur and provide the users with instructions for the periodic inspection and maintenance. Included should be signs of impeding failure. Also, the engineer can help prevent accidents by sharing his data and experience through sales and service people with the customer and user.

Lastly, the author suggests the use of A Product Safety Review Team, made up of a broad spectrum of technologies and viewpoints, which could evaluate an engineer's product.

2.5 The Litigation Process

The litigation process can be divided into several steps. These steps do not necessarily go in order or sequence, but they do represent the basic and elemental parts of a legal process of litigation. The segments of the litigation process are as follows:

- The claim (Summons and Complaint) – the start of the lawsuit is the filing of the claims in a "Complaint" along with the plaintiff's request to the court for trial and redress for the damages. The claim has to be clear enough and logical enough to justify the court to continue the process.
- The response and defense (Answer) – the next general step in the process is the response, or "Answer." The defendant is given a reasonable time to study claims and allegations and to make a response to those claims. This claim and denial process leads to a full-blown litigation process – unless one side or the other gives in enough to effect a settlement. At the time of the response, or shortly after, the defendant will list his defenses, or the other gives in enough to effect a settlement.
- The discovery process – the segment in which both the defendant and plaintiff discover all possible and proper information relating to the incident and the trial. Under the rules of litigation, each side is allowed to "discover " relevant information, what the other side contends, and the basis for those contentions. The discovery process includes five parts, which are:
    (1) Interrogatories – this is simply a set of questions that each side serves upon the other in a formal way, with the powers of the court demanding appropriate answers within some time limit.
    (2) Requests for Production (RFPs)– each side will ask the other to produce written and physical evidence and information by this process. The plaintiff may request prints of the machine and its parts, service records, etc. The defendant may request photographs, accident reports, medical records, etc.
    (3) Requests for Admission (RFAs) – the attorney, following the rules of law and of the court, must "make his case" in a certain form and

following certain steps. That means he must show and prove certain things in order to have properly presented his case. Admissions are responded to by saying, "admit" or "deny."

(4) Inspections – inspections of the machine or parts involved, the accident site, the injured person, and other relevant things may be necessary or desirable in the discovery process. Technical inspections, by consultants or experts, are frequently made under the watch of the opposing side, through that is not always done.

(5) Depositions – in a deposition, a witness or potential witness, or someone believed to have information or knowledge relating to the matter at hand, is asked questions in a special circumstance. Depositions are given before a court reporter and under oath, just as they would be at trial. However, the atmosphere is more informal.

- The trial – the trial will consist of the choosing of a jury, opening statements by each attorney, the presentation of evidence and witnesses for the plaintiff, the presentation of the case for the defense, final arguments by each participating party, the jury charge, the jury deliberation, and the verdict.
- Post-trial activities – may be handshakes all around and agreement that the court has led the participants to a reasonable and proper decision. Then there are motions for retrial, judgment notwithstanding the verdict, reductions in judgment, and a variety of other legal steps that are entirely the province of the attorneys.
- Settlement – a resolution or settlement usually comes after the trial and all of the appeals.

2.6 Engineers And Engineering Information

Engineering information and judgment are critical for the successful conduct of a court case and the arrival of a proper equitable resolution. This type of information is important because the juror or the judge is unfamiliar with the information in a products liability matter in a court of law. Engineers typically testify as either fact or expert witnesses in such situations.

This chapter contains a section on why engineering information is important. First, what is engineering information? Engineering information is the data and discussion about a design that is recorded. This obviously includes blueprints, which represent the final form and detail of the design. Also, included are any letters, memos, policy statements, procedures, and similar paper documents that may be important to the design of a product.

The next section entitled, *Information and the Plaintiff*, claims that the plaintiff will be interested in the engineering information as a basis for evidence that there was a defect in the design or that there was negligence in the process.

Of course the next section, *Information and the Defendant*, shows how the defendant uses engineering information. The defendant in a lawsuit needs good engineering information to show that his design is proper, that it is safe, and that it did not cause the incident for which the suit was filed.

The section, *Where is the Information?* is self-explanatory. Basically, engineering information is in any of the sources of information that you use in designing and developing a product and maintaining the design. The information may be any of the various places that such data was created, used, processed, stored, or translated into something else.

Now the author moves on to the next question, "*Who Can Explain the Information?*" Generally, the best source of information would be the person responsible for the product or design. The second best source would be someone familiar with that type of product, either by experience or by use and application of the product. A third possible source would be an engineer with the basic training and ability to understand the principles of engineering and those processes involved in design and testing products.

So how does engineering information fit into the litigation process? Information is evidence or, at least, potential evidence. It may be offered as proof that a product is defective, or it may be offered as a rebuttal to claims that the product is defective in terms of safety. In either position, it is potentially evidence.

2.7 How The Engineer Can Help The Attorney

The chapter begins by explaining that the attorney thinks and reasons in what appears to be a different way than you do as an engineer, and vice versa. It is important that the engineer understand that he is assisting, and that he conducts himself in that way. It is the attorney who should make the final decisions as to whether and how information and how that information and understanding should be presented.

Next, the author presents a number of suggestions of how engineers can assist attorneys. Those suggestions are as follows:

(1) Be knowledgeable of the design and development process.
(2) Explain products, systems, parts, and operation of the machine.
(3) Explain how the product is developed, evaluated, and tested.
(4) Be able to explain why a product was or was not successful
(5) Know how to test or analyze a product or show demonstrations.
(6) Be familiar with the uses and application of the product.
(7) Know the relationship between a machine and its operator.
(8) Be technically equipped to conduct accident reconstruction.
(9) Be knowledgeable of state of the technology in the product field.
(10) Be willing to summarize technical engineering literature for the attorney.
(11) Assist the attorney in examinations, interviews, and depositions of those involved in the case.
(12) Be able to list possibilities, practical scenarios, and likely conditions and results, thus limiting the blind alleys that might be searched and getting into alleys where the real value is.
(13) Be able to translate technical information into common language, to assist both the attorney and others.
(14) Be able to evaluate the mathematical science of possibilities and risks involved in the case.
(15) Know how to explain complex technical processes.
(16) Listen and react both as a technical person and as a layman.
(17) Be prepared to testify in both the deposition and at the trial.

(18) Provide reports and written materials that explain in great detail your beliefs and technical opinions relating to the case.

(19) Be willing to suggest questions for depositions and cross-examination of opponents. Also, suggest questions that the attorney should ask you during your own direct examination in court.

2.8 The Discovery Process

The discovery process is a legitimate process for an opponent in a lawsuit to discover information that is permitted by law to be found and possibly used in the matter being litigated. Typically, any information about the product, the philosophy, the design, the process, testing, analysis, etc., can be discovered. It is important that the attorney direct and guide the handling of matters involved in discovery. This is legal territory. Also, no matter what side you are on, you need to know about the other side as much as you can and the law allows you to "discover" any information that is relevant to the matter under litigation.

There are a number of methods of how to obtain information. One of these methods is inspection. Inspection of the site of the accident, of the equipment involved, and of similar or related items may give important information. Other obvious, but less used methods are the library, trade journals, competitors, or interviewing machine users and asking questions.

Even though there are five parts to the discovery process, this chapter concentrates on only three, interrogatories, request for production, and request for admission.

Interrogatories are simply asking a question and expecting an answer. The opposition will respond in some fashion to the question. If the two parties do not agree that the question has been properly asked or answered, a judge settles the matter by a ruling, ordering one side or the other to ask or respond properly.

An attorney may file a Request for Production in order to acquire physical evidence such as documents. By doing so, an attorney may discover a mass of data and information, rather than the simple limited answer to one question. Usually the request asks for documents that have known groupings of information. Both sides (plaintiff and defendant) will generally ask for witness statements, information about witnesses and potential witnesses, information about experts expected to testify, etc.

If the defendant files a Request for Admission, they have totally and completely agreed that the statement propounded by the opposition is true. Remember if any part of the statement is incorrect, deny the admission. Sometimes an explanation of the denial is appropriate. An admission then becomes evidence that no longer needs to be proven or demonstrated by the opponent.

2.9 The Deposition

The discovery process usually includes depositions, wherein the attorney for the opponent is allowed to question a witness under oath and before a court reporter, but outside the courtroom. The questioning is less formal than in the courtroom trial, but the deposition's process is extremely important. The deposition usually is conducted when the matter is getting closer to trial; at least chronologically, the deposition may tend to trail other forms of discovery. Because it is closer to trial, it tends to have more to do with trial strategy than other forms of discovery.

The deposition presents your first chance, as a witness, to deal directly with the opposing attorney. It will also be the attorney's first opportunity to deal directly with you. The attorney will ask you questions and you will answer them. It is important to note that cases have been lost or irreparably damaged by things said and done in deposition. What you say in deposition is just as important as what you say in the courtroom.

The author next presents a list of general rules for deposition. Those general rules are:

- Listen to the question – make sure you hear it and understand it. If you do not listen to the question carefully, you cannot answer it properly. If you do not understand the question, say so. Ask the attorney to repeat the question, or tell the questioning attorney that you do not understand the question.

- Pause before you answer the question – make sure you are about to give the proper and true answer to the specific question asked. Second, if any one of the attorneys at the deposition has any objection to the question, he needs time to express that objection. Third, you will feel more as if you are controlling the pace of the deposition.

- Answer only the question asked – the deposition and the discovery process are based on the assumption that the questioning attorney will ask questions for which he wishes answers. You are under no obligation to give him more information than he asks for. If he fails to ask some question, that is his problem.
- Answer truthfully and completely, to the best of your ability – regardless of whether you think the answer will hurt your effort or is good or bad, give a truthful answer. Any falsehood will damage your attorney's case and may well destroy your usefulness as a witness. Further, you will be in danger of criminal action and punishment for perjury.
- Do not volunteer – often there is silence between your answer and the next question. Do not fill in the silence by adding information, or explaining your answer, or by any of the other things you think may help. They might help, but your job is not to make this determination. Sometimes open-ended questions will be asked, giving you the opportunity to answer at length. Answer only what is needed to answer the question. Answer both truthfully and properly.
- Do not argue or advocate – you should not go beyond responding to questions with true answers. If there is any arguing to be done, leave it to the attorneys. When you start to argue you lose your perspective and fall into saying things not required of you. The questioning attorney may even try to get you to do that. Do not get trapped.

After a discussion on general rules for depositions, the chapter goes on to list the reasons for depositions. The seven reasons are:

- The purpose of discovery – aimed primarily or entirely for the purpose of discovering or obtaining information.
- To establish facts and to determine the origins of and bases for those facts – information is the substance from which good cases and good case presentations are made. The attorney must have all the information relevant to his case both

good and bad. Without all of it, he may have holes in his argument and blank spots in his logic.

- To determine the opinions an expert witness may offer at trial, and to explore the basis for those opinions – generally, a layperson may testify only about what he has seen or otherwise sensed firsthand. He may not usually give his opinion. Because expert witnesses are allowed to give opinions, it is important for the deposing attorney to learn of those opinions and to explore the bases of those opinions.
- To seek information and bases to impeach the witness, if such opportunity exists – there are proper ways to discredit a witness. One way is by showing conflict between what he says in court and what he said in the deposition. Another way is to show obvious errors and discrepancies in the testimony of the witness. Still another is to show bias by the witness, in favor of his client.
- To pin down testimony, so it may not be changed at trial – by "pinning down" the witness in deposition, the attorney has pinned down the testimony so it is unlikely to change at trial.
- To preserve testimony for trial – in the event that the witness cannot appear at trial and testify live, the deposition will preserve the testimony and it usually can be used at trial just as if the witness was there. Recently, there has been a growing trend toward videotaping depositions, both for the purpose of preserving testimony and for assisting or replacing the court reporter.
- To use the deposition as a means of learning the plans or strategy of his or her opponent – this is a double-edged sword: you may learn about the opponent, but at the same time, he may learn your strategy, too.

The chapter then goes to describe what a corporate representative is. A corporate representative, called a 30(b)(6) by attorneys, usually represents a corporation (that you work for) that is a defendant in a lawsuit. The rules in questioning are no different from any other deposition.

The next topic in this chapter deals with fact witnesses and expert witnesses. A fact witness usually has first hand knowledge or involvement with a part, a design, or a test involving the product. If you are a designer, you may be asked to explain the design, and how you arrived at it. You may also be asked what else you considered, and why you chose a particular design. An expert witness usually offers opinions based on expertise in a particular field. Remember, the expert witness may offer opinions, while the lay witness generally cannot.

Generally, the expert witnesses for the plaintiff and the defendant will have different objectives. For example, the plaintiff's expert witness will try to offer opinions concerning defects or other inadequacies, and their relationships to the accident. On the other hand, the defendant's expert will show that his client's machine is not defective or that his client was in no way responsible for the accident or loss. Further, he will have to deal with the alternate designs or ideas suggested by the plaintiff's expert as prevention to the subject accident.

2.10 The Trial

The trial is the high point of the litigation process. At this time, the parties to the case have reached a situation where they cannot agree on a suitable resolution to the matter. They have then decided to submit their claims, contentions, arguments, and beliefs to a court – probably including a jury – with the expectation that the court will arrive at a proper resolution of the matter. Remember that the trial does not take place until all pre-trail activities have taken place.

Trials are guided by rules and procedures set up by the court and for the conduct of the court process. The trial steps are:

- Picking a jury
- Opening statements
- Final arguments
- The charge to the jury
- Jury deliberation
- The verdict

Next the chapter presents the key players in the courtroom during the trial. They are:

- The judge
- Court clerk
- Court reporter

- Marshal, and
- Jury

Lastly, remember proper appearance and conduct in the courtroom. You should wear clothes that make you appear businesslike. Courts and judges deserve that respect. Conduct yourself is a quiet, dignified manner. Courts are serious places and you should not act otherwise. Also, when asked questions, answer truthfully – but no more. Do not volunteer and do not help the attorney.

2.11 Questions

Chapter 11 deals mainly with the art of answering questions in the proper manner. As a matter of fact the text states, " Much of what the engineer does, in litigation is answer questions." As discussed in the text, there are various types of questions and there are correct and incorrect ways to answer them. The main thing to remember when answering a question in litigation is to be truthful. In order to succeed as a key witness, the main theme is to be honest, straight forward, and most of all-truthful.

The first topic discussed is the various situations in which questions are asked. As a potential expert witness you will probably be asked questions by almost anyone involved at any given time. However as the witness, you must answer these questions truthfully and as best as you possibly can. It is your job as a potential consultant to have an answer to most, if not all, questions asked. This way you may maintain your integrity as a key witness.

The next topic touched upon is the various types of questions asked. There are numerous types of questions asked in litigation, normally grouped in pairs of opposites. The first pair is specific and general questions. General questions are broad and are aimed not at receiving a direct answer, but a general condition. The best way to answer this type of question is to give a brief and polite answer. Specific questions, on the other hand, are asked for a direct answer. Hence the best way to answer these types of questions is to give a specific answer.

Open and closed questions are the next pair to be considered. Open-ended questions are asked for detailed or narrative answers. Closed questions are mainly asked in order to receive a yes or no answer. In both circumstances it is a good idea to be straightforward and honest in your answers.

Other types of questions are leading and non-leading questions. These types of questions are used the most in trial testimony. Basically leading questions are asked to suggest an answer. They limit and control the person whom they are directed toward. Non-leading questions are the opposite of leading questions. They do not suggest answers and leave the person to answer the question alone.

Formal and casual questions are another form used. Formal questions are highly important in trial. They consist of the questions asked in documents such as in interrogation, deposition or even the trial itself. The answer must be thought out in great detail, because it is being recorded and can be used in the future to prove your incompetence. Casual questions are less formal and are asked in laid back situations. They are not recorded for future use, yet you must be careful of what you say. It can become as powerful as a formal question in court.

Rhetorical and interrogating questions are pretty much straight forward as far as definitions go. Rhetorical questions are asked not to receive an answer, but to emphasize or summarize a situation. Interrogating questions are asked for a simple answer, nothing more.

There are also simple and complex questions. Simple questions are any question that is easy to answer. They require a simple answer and are not meant to confuse the person answering. On the other hand, we have complex questions. This type of question usually contains complex grammar, added questions, and is sometimes asked hypothetically. They are used to confuse the person answering, overall attempting to hurt their creditability.

The last types of questions asked are probing and outlining questions. Probing questions are in search of a direct answer, and essentially they look for answers. They are easy to answer and are highly straightforward. Outlining questions are used to lead the jury in the direction as wanted. Most of the time these questions are objected to, because they are illegal. However they are used to get the attention of the jury.

The text also talks about the various people who ask these questions in litigation. The general rule is to only talk about the subject at hand, and only with your attorney. When outsiders ask questions, you should decline to reply unless authorized by your attorney. This is because your answer could be used against you at a later time. Hence it is important to know whom you are talking to and how to limit yourself.

Next the text discusses the different questions that they ask. As discussed earlier, there are various types of questions that can be asked. Some are perfectly legal to ask during litigation, while others are outright unreasonable. In litigation there are many rules that attorneys must follow in order to question a witness. It is your attorney's job to make sure the competition abides by these rules.

Lastly the text talks about the way questioners ask questions. As you know people ask questions in different ways to obtain an answer. Some questioning sessions can become heated. In these cases, try to slow down to lower the tension. It is important to listen to the questions being asked, because it can be fatal if answered wrongly. Overall it is important to keep answers simple and slow. Answer the questions with a lot of thought, because an attorney can bend your words into what he or she wants to hear.

2.12 Accident Reconstruction

One of the most important parts of a trial is the reconstruction of the accident. In product liability cases, it is important to create a picture for the jurors involved. One side must recreate the accident, because litigation occurs due to disputes, and disputes occur in product liability cases due to accident or injury. In order to prove that the product under scrutiny was essentially at fault for the plaintiff's injury, the attorney must paint a picture of the accident. This is done through the testimony of witnesses, eyewitnesses, and specialists in the field. Physical evidence is also needed to prove a product is at fault. Where do you draw the line between human and mechanical error and whom should be placed at fault? The attorney must prove to the jury his perspective on a topic.

Good accident reconstruction is essential in not only understanding what happened, but is key when presenting a case to a jury. For example, the attorney for the plaintiff will have an accident reconstructionist develop his own concept of what happened in order to win. A defendant will also do the same thing, however, in attempt to prove that the product under fire is not responsible, saving his defendant. A good accident reconstructionist uses lots of visual aids, has an in-depth knowledge of the working parts of the product, and can relate all of this to basic sciences, in order to determine the most likely scenario.

Accident reconstruction is accomplished by recreating the accident as it happened. It does not necessarily have to be reenacted, but a story must be set up on a time basis. In order to set up the story, you must start by pointing at any evidence, testimony, witness statements, broken parts, photographs, etc. It is then important to create various scenarios. After numerous scenarios have been established, the reconstructionist must go through each one and rate each one according to their probability. Eventually the reconstructionist is able to find a believable accident that is backed up by various pieces of evidence. In order for an accident to be believable, a good scenario must abide to the laws of physics. It must also agree with the evidence that is available. The scenario must also be explainable, free from bias, and clearly explained so not to surprise the jury.

2.13 Definitions and Techniques Employed by Attorneys

Chapter 13 consists of various definitions that are heard commonly in and around litigation. Here is a list of them with a brief definition of each:

Adverse Witness: A witness that has been called on by the opposing attorney.

Answer: Formal term for a response.

Appearance: A figure appears in the litigation process

Arbitration/Mediation: An alternative to actually going into litigation, usually due to time constraints.

Balance of the Evidence: The information/facts placed in front of the jury by both sides involved in litigation.

Bar: 1. Location of legal activity. 2. A grouping of attorneys in a certain area of jurisdiction. 3. To keep out

Bench: It is where the judge sits. However, it is also considered the focal point of litigation.

Best Evidence: Deals with the acceptability of evidence.

Breach: Failure to perform or a break in a chain of action.

Burden of Proof: The responsibilities of the parties in a lawsuit to prove/disprove the claims at question.

Care: The responsibility or charge to perform or conduct according to accepted levels of performance.

Charge: Specific instructions as to how it must proceed in deliberating a case.

Civil Law: Law dealing with relationships between people, and other entities.

Complaint: Formal name for the list of claims and the request for court intervention.

Due Process: Proper legal steps in a procedure.

Duty: What a person is supposed to do in litigation.

Evidence: Information that proves or disproves matters of disputed fact.

Exhibit: Evidence offered and admitted at trial

Expert Witness: One who, by training, education, experience, or special knowledge, has the ability to assist the court and the jury in understanding technical aspects of a matter.

Facts: Things that have happened or matters that truly exist.

Forensic: Means " Belonging to law."

Foresee ability: Implies the ability of a matter, situation, condition, or action to be expected sometime in the future.

Good Faith: Type of effort made by one who has a duty.

Hearsay: The admissibility or inadmissibility of testimony from a witness.

Hidden Defects: A defect hidden from view or not easily detectable even by reasonable and common inspection of a product or component.

Hostile witness: A witness who by either his actions or demeanor demonstrates a hostile attitude toward the questioner

Hypothetical Question: A form of question permitted at certain times and with certain requirements during a direct or cross-examination.

Impeach: To show the testimony of the witness to be untrue or unbelievable.

Inadmissible: Evidence that is not allowed into trial

Irrelevant: A subject that is not a necessary piece of evidence in regards to the trial.

Judicial Discretion: A form of judgment dealing with a particular topic

Jury Trial: Trial using a jury of people to decide the facts of the matter.

Lay Witness: Usually an eyewitness, they testify for the facts of the trial.

Liability: Legal responsibility to pay or provide such remedies as the court decides.

Litigation: The total process of filing a lawsuit, pursuing the discovery and other pre-trial actions.

Mistrial: When a judge determines that a fair and proper resolution can no longer be reached.

Oath: A promise to tell the truth

Privileged Communication: A transfer of information not generally discoverable by the opposing side in a matter of litigation.

Proximate Cause: An accident, injury, or related loss is that cause without which the incident would not have happened.

Prudent Person: A person who conforms to the rest of the group.

Puffery: When a person stretches the truth in order to sell their side of the story.

Punitive Damages: Damages over and above the damages intended to make the plaintiff whole.

Question of Fact: Questions or unresolved disputed dealing with facts or information.

Question of Law: A matter of dispute concerning the applicable statutes or precedents, or a dispute concerning the process and rules of litigation procedure.

Reasonable Care: The care that a reasonably prudent person, properly trained and assigned to the work, would use in performing the work.

Red Herring: A diversion or interruption used by attorneys, judges, and jury's.

Side Bar: Side of the judge's bench where parties can privately discuss objections with the judge.

Summons: A legal document notifying the defendant that an action has been filed against him/her.

Testimony: The questions you answer while on the witness stand from both parties.

Tort: legal wrong committed or perceived to be committed against a person of other legal entity.

Warnings: A complaint or claim center around the question of adequate warning.

Weight of the Evidence: The importance of evidence forces the scales of justice to tip toward one party or another.

The text then goes on to describe different techniques used by attorneys. The first topic discussed talks about how an attorney should never ask too many questions. Once your point has been proven, end conversation. It also discusses how you should never argue or fight with a witness. The cross-examination is also touched upon; according to the author, it is essential to keep it short and straightforward. Overall, it talks about being short and to the point. We all know nobody likes to listen to long and boring litigation.

2.14 War Stories

This chapter consists of war stories collected from attorneys. These stories are passed on from lawyer to lawyer; some are humorous while others ridiculous. For example, one story depicts how during one trial, a vice president of a particular company answered "I don't know" to every question asked. This was his actual honest answer to these questions, too. This goes to show how frustrating it can be as an attorney.

Another "war story" deals with surprises. In this case, an expert witness on the stand testified about the use of an earthmoving machine. When asked if the machine had been tested in traffic, he replied, " no sir it wasn't necessary." The attorney did not expect this curve ball, and the entire testimony was claimed useless.

Overall, Chapter 14 deals with real life situations that occur in the court of law. It is a reminder of how cases do not always go by the book. It is the author's way of showing the reader what can happen, and what actually happens in the real world during litigation.

2.15 Tips for the Engineer Involved in Litigation

This chapter lists a number of steps to follow when involved in litigation. During litigation, engineers are solely in charge of giving advice. As a key witness, it is the engineer's job to be honest and truthful. When being questioned, an engineer must use his good judgment. He/she must think before responding. As a professional in his or her field, answers should be crisp and concise. When an engineer makes an error, it is important to accept the fact and move on. However, the most important point that exists in the chapter is for the engineer to tell the truth at all times, no matter what the effect might be on his/her clientele.

3 Products Liability in a Nutshell

By Jerry J. Phillips

3.1 Definition and Scope

The book begins with the definition and scope of a product. Essentially a product is a tangible personal property more or less known as a "good." However products liability has extended beyond tangible goods to include intangibles. The book discusses product liability as a wide range of casework. Basically, product liability is the fact whether or not the defendant is in the best position to spread the loss and prevent injuries, and to other policy concerns such as freedom of speech and difficulties of proof. If the case falls within these guidelines one might be dealing with a product liability scenario.

One of the main reasons for imposing liability against a product supplier for injuries resulting from a product is because the product is supplied in a defective condition. A defect is essentially anything actionably wrong products when they physically leave the sellers hand. It is often stated that there are four types of product defects: manufacturing or production flaws, design defects, defective warnings or instructions and misrepresentation.

There are several ways to test for defectiveness of a product. The first technique is the actual customer's expectation as to what the product should deliver. According to the sales article in the UCC, in order for products to be merchantable they must not be sold in a dangerous condition. An example of this would be having ground glass in your food. Another defectiveness test that is used is known as the seller's knowledge. A seller would be negligent in placing a product on the market if he/she had knowledge of its harmful or dangerous condition. An additional technique is the Risk-utility. Risk-utility more or less is the same as risk-benefit analysis. The entire issue is whether the cost of making a safer product is greater or less than the risk or danger from the product. If the cost of making the change is greater than the risk created by not making the change, then the benefit of keeping the product outweighs the risk and the product is not defective. The last technique discussed by the book is unavoidably unsafe products. There are some products, which in the present state of human knowledge are quite incapable of being made safe for their intended and ordinary use. The drug industry is a prime example of this technique. An example of this would be a vaccine, although vaccines are designed to protect you from disease, they sometimes contain live viruses, which in turn infect you. This is an unfortunate circumstance that is unavoidable when dealing in such.

The second Restatement of Torts states that one who sells any product " in a defective condition unreasonably dangerous" can be held strictly liable for injuries resulting from the use or consumption of the product.

3.2 The Causes of Actions and Damages

Various production methods lead to product defects. The first one described is negligence. Negligence can arise in numerous ways. It arises through inadequate inspection, processing, packaging, warning, design, marketing, or in any way in causing injury to the plaintiff.

Another breach of negligence can arise when there is a violation of a penal statute. Mislabeling a product in violation of the federal food, drug and cosmetic act would be negligence. Another form of negligence is reckless misconduct, concealment or deceit. An example of this would be the famous Ford Pinto Case. Ford knew about its design flaws with the placement of its gas tank. Eventually, it led to the loss of over 125 million dollars.

The privity requirement is one of the hallmarks of modern product liability. Through the years common law has evolved to adapt to the changes in times. The same has occurred with privity requirements. The main contribution to this fact was the warranty law, such a notice of breach, led to disclaimer and warranty statute of limitations.

3.3 The Parties

The plaintiff may sue any product defendant on any available theory to recover for personal injuries. The plaintiff need not be a buyer; user or consumer, and any foreseeable plaintiff including bystanders can recover for personal injuries. An example of this, which indeed will become a future concern, is secondhand smoke. Those who are subjected to secondhand smoke are legally able to collect in certain circumstances. The plaintiff who suffers from witnessing an injury of a close relative or close friend in a car accident, for example, can recover from resulting injuries. Rescuers of a person injured by a defective product are widely permitted to recover against the product manufacturer or seller for injuries incurred in the attempted rescue.

Not only can the final assembler be sued, but a manufacturer of a component part can be sued as well. If the part is defective when it leaves the component manufacturer's hands, or if the specifications for the component obviously indicate that it will be dangerous when incorporated into the finished product they can be sued. Retailers can also be sued if they do not inspect or test the assembled product. However under Rest.2d of Torts 402A there is no liability on a retailer if it is in a sealed container.

A number of states, by stature or common law, permit a tort action by an employee against their employer, outside the exclusivity provisions of workers compensation, where the employer engages in international misconduct causing injury to the employee.

Service is another area in which deficiencies take place. A product defective in manufacture or design often is defective, for example, because of some service performed or not performed by the manufacturer.

3.4 Factors Affecting Choice of Remedies, Jurisdiction, and Procedure

The main factors of remedy like disclaimers, limitations or remedies and notice of breach are often associated with warranty litigation, as is solely economic loss. The reliance element is associated with misrepresentation. The government contractor defense and immunity limitations tend to permeate the law of products liability.

Proof of reliance is expressly required as a condition to recover for conscious misrepresentation, negligent misrepresentation, and an innocent tortuous misrepresentation resulting in personal injury.

Many courts hold that a plaintiff cannot recover in tort, either in negligence or in strict liability, when he or she has suffered solely economic loss from a defective product. The plaintiff's remedy for solely economic loss is in warranty and the warranty remedy is available only if there is privity of contract. Although some courts make no distinction between economic loss and physical injury they allow recovery.

A wrongful death action is typically a creature of statute, rather than common law cause of action. Most of the statutes speak in terms of an action for death resulting from a crime, negligence, carelessness, wrongful act, or default of another. Courts have had no difficulty in allowing a tort action based on such statutes, whether brought for recklessness, negligence, or strict liability.

A number if state legislatures have enacted statutes cutting back on consumer rights in the area of product liability, in an attempt to meet a perceived crisis in availability and affordability of liability insurance owning to a quantity of litigation and size of verdicts. A federal court sitting in diversity jurisdiction, under Erie doctrine, states that court never reaches the question how the forum state court would treat the same issue for conflict of law purposes. Instead, it applies its own procedural rule.
It remains to be seen whether such statutory retrenchments will generally be upheld as constitutional, and if so whether they will reduce insurance rates and the amount of litigation and damages recovered. Assuming the amount of tort litigation and verdicts is increasing; it does not follow that the increase is either good or bad. Such an increase, moreover, is not particularly indicative of the status tort claims. Since the vast majority of tort claims made are never litigated.

3.5 Production and Design Defects

Courts refer to manufacturing flaws as distinct from design defect. To prove that there are general defects the product must not conform to the manufacturer's specifications. An example of this would be if a manufacturer determined that a 20% failure rate was acceptable, none of the products falling within this range of failure should be considered defective. However, if they were not inside this 20% range then they would automatically be deemed defunct.

There are significant variations on the definition of design defectiveness for strict liability. In a negligence case, the inquiry focuses on the reasonableness of the manufacture choice of design, in light of the knowledge available at the time of manufacture. Under strict liability, knowledge of the danger as revealed by the accident and the testimony at trial is imputed to the manufacturer.

A product may be found defective in design if the plaintiff establishes that product failed to perform, as safely as an ordinary consumer would expect, when used in an intended or reasonably foreseeable manner. Another way is if a product is alternatively found to be defective in design. If the plaintiff demonstrates that the products design remotely caused their injury, and the defendant fails to establish an effective failure rate, then the defendant will be found liable. Another defect of a product can be defined as Crashworthiness. This term is used to describe the capability of a product to protect against injury from an accident caused by something or someone other than the product.

3.6 Inadequate Warnings and Instructions, and Misrepresentations

Overall, plaintiffs will allege a failure to warn, along with a design defect count, in production liability suits. They are not required to make a choice between pursuing a case on a strict product liability theory of either design defect or failure to warn. The plaintiff also has the burden of showing that, had a warning been given it would have caused them to avoid their accident. A warning is distinguished from an instruction in that instructions are calculated primarily to secure the efficient use of a product, while warnings are designed to insure safe use. To be adequate, a warning must describe the nature and the extent of the danger involved.

When a manufacturer is issuing warnings on their product, they should first take into account the environment in which its product will be used. The manufacturer is required to anticipate the misuse of the product and properly warn against it. Usually a warning is not required if the action is an obvious danger. If a user is somehow misled or a seller downplays the danger within a product the manufacture can be held liable.

Misrepresentation can arise in a variety of contexts. It can be based on deceit, negligence, strict tort, or strict warranty. No defect needs to be shown, other than the fact that the misrepresentation was made and proximately caused the plaintiffs injury. Strict liability for misrepresentation is imposed, based either on warranty or tort; a number of these product defenses and liability limitations can be avoided. The product supplier who makes an innocent misrepresentation may not be able to rely on a state of the art defense.

3.7 Problems of Proof

The plaintiff generally must show not only that the defendant's product was defective and that the defect caused their injuries, but they must also show that the defect existed when the product left the defendant's control. This is completed by the elimination of alternative causes not attributable to the defendant. They do not need to identify the precise defect that caused their injury. Where a defect attributable to the defendant is established, courts may be more willing to allow an inference of causation than they would if no such defect is shown. Generally, the newer the product, the easier this objective is for the plaintiff. This is mainly due to the fact that newer products usually have fewer problems.

The three major types of plaintiff misconduct that can bar or limit the plaintiff's recovery are contributory negligence, assumption of the risk, and misuse including alteration of the product. Contributory negligence is the failure of the plaintiff to take reasonable care for his own safety. Assumption of the risk is the knowledge of an appreciated risk. Misuse is the use of a product in an unintended or unforeseeable manner.

Misusage of a product is one of the main defenses used. Misuse is usually not treated as a bar to recovery unless it is considered unforeseeable. Unforeseeable misuse is a bar, while foreseeable misuse is not. Misuse, when attributable to the plaintiff rather than a third person, is closely related to contributory negligence and assumption of the risk. A product is defective when it is unreasonably dangerous for normal or foreseeable use.

Comparative fault is another problem when involving proof. If the plaintiff is permitted to recover, his recovery will be reduced by the percentage of fault. Spoliation can also contribute to problems of proof because the person willfully or negligently disposes of product evidence vital to a litigant's case. Expert testimony is another problem of proof; this can work in favor of either the plaintiff or defendant.

4 Kenneth J. Bartow vs. Extec Screen Machine

4.1 Background

On the morning of December 16, 1994, Kenneth R.Bartow, the plaintiff, was injured while working for the O'Connor Brothers, Inc., located in Sheffield Massachusetts. At approximately 7:00 A.M. Mr. Bartow assisted Harold Green, also an employee of the O'Connor Brothers, load his truck for a delivery. Mr. Green then left for his destination. As he later stated in his deposition, the entire trip took close to 1.5 hours. When Mr. Green returned to the scene, at roughly 9:30, he noticed that Mr. Bartow's truck was running, however Mr. Bartow was no where to be found. He then looked over at the machine Mr. Bartow had been operating. He noticed Bartow on the ground near the machine. When he went to assist Mr. Bartow, he noticed that Mr. Bartow was seriously injured. Mr. Green then proceeded to call an ambulance and Mr. Bartow was taken to nearby Fairview Hospital located in Pittsfield, MA.. According to the medical reports found in this case, Mr. Bartow sustained the following injuries (recorded by Dr. Raym Sabatelli at 1 PM on the day of the accident):

- Shoulder

  Multiple projections of the shoulder do not reveal any fracture or dislocation. The acromioclavicular joint appears intact. No abnormal sort tissue calcifications are demonstrated.

  Impression: UNREMARKABLE EXAMINATION

- Lumbar Spine- AP, Lateral and Coned-Down Lateral

  AP lateral and coned-down lateral views were obtained. The vertebrae were normal in height, configuration and alignment. Disc space heights are intact. There is no evidence for fracture.

  Impression: UNREMARKABLE EXAMINATION

- Thoracic Spine

  Ap and lateral views of the thoracic spine show mild mid thoracic degenerative changes characterized by anterior and lateral osteophytes. In addition, there is mild compression deformity of the T-7 and T-8 vertebral bodies without evidence of adjacent soft tissue swelling and which appears to be chronic; however, there are no old studies to allow for comparison. No definite acute fractured or sublexation is identified.

Impression: MID THORACIC SPINE CHANGES DESCRIBED ABOVE

To this day Mr. Bartow is still in pain. His long list of medication is just an example of how physically and mentally tarnished he is. How did this happen? Who is at fault? Let's take a look at the rest of the deciding factors before making a final decision.

4.1.1 Bartow's Deposition

Upon reading the first section of the deposition, one can see Mr. Bartow's extensive history with the use of heavy machinery. His fairly lengthy resume shows the various positions he has held around heavy machinery. Mr. Bartow has worked as a mechanic, carpenter, and most recently as a heavy machine operator. It is also relevant to note that Mr. Bartow has had a history of being injured while on the job. For example, in 1980, while working for the Mass Turnpike Authority, Mr. Bartow injured his back. Apparently he was lifting a disc brake off of a FWD Tandem truck with a fellow employee. According to Mr. Bartow, the employee helping him let go of the disc brake, leaving him to carry the load alone. The weight of the brake was so heavy that Mr. Bartow suffered a back injury. This injury ultimately required surgery in order to alleviate the back pain.

It took four years before Mr. Bartow's pain resided enough so that he could return to his work with operating heavy machinery. At this point, the O'Connor Brothers hired Mr. Bartow. The O'Connor Brothers, a gravel and excavating company, hired Mr. Bartow to operate their heavy machinery. Mr. Bartow was given the task of running a screen machine. According to Mr. Bartow, he naturally obtained the skills to run the screen machine simply from his past experiences with operating heavy machinery. After working for the O'Connor Brothers for several years, he became extremely acclimated to using the screen machine.

The O'Connor Brothers, Inc., in mid to late 1994, decided to purchase a new screen machine. Their old machine, a portable power screen, was becoming old and simply could not keep up with demand and workload. Mr. Bartow, due to his work experience, was brought in to aid the decision process. After several demonstrations from various sales representatives to the O'Connor Brother, Inc. one machine stood out as being on top: The Extec Screen Machine, produced by Extec Screen & Crushers LTD (the defendant in this case), a British based company. Jack Gilfoil was the sales representative from the Pennsylvania branch office of Extec Screen & Crushers LTD that sold the machine to the O'Connor Brothers for $95,000.00. Mr. Bartow himself admitted to choosing the Extec Machine over the others due to its performance. The screen machine was purchased and delivered to the O'Connor Brothers just before Christmas of 1994. The machine got its first routine use a few months later in March 1995. It was not used consistently prior to this date due to poor weather conditions. According to Mr. Bartow, the machine could not be used if the soil/rock that you are trying to screen was frozen. The reason being that the material gets caught in the screen, causing further delays.

Bartow taught himself how to operate and perform the required maintenance in order to keep the machine in good running condition. According to Mr. Bartow, there was only one occasion where it was necessary for the O'Connor Brothers to call upon somebody, other than himself, to fix the screen machine. Mr. Bartow said that for a period of time the machine was not running properly. He stated "Russ Jr., Co-owner of the company, or Dickie Bassett, fellow employee, called Extec in PA. Some of the belts were constantly being run off. So two Extec employees came out to the sight. They sounded as if they were from Ireland or England. They did all the maintenance and replaced the belt on the machine. However, it took them a month to get the machine running properly."

Other than this instance, the screen machine required only minor maintenance. In his deposition, Mr. Bartow discussed the maintenance he performed, i.e. " adding hydraulic fluid or changing the oil." Another task of maintaining the Extec machine was changing the screens or grates used in separating the gravel. According to Mr. Bartow, it was this task of changing screens and gates that lead his injury.

4.2 General Accident Description

The following is an excerpt from Mr. Bartow's deposition. In this except, the letter Q stands for the question asked by questioner (in this case, a lawyer) while the A represents the answer given by Kenneth Bartow. This excerpt discusses from Mr. Bartow's viewpoint, how he was injured while changing the screens on the Extec machine he operated. As mentioned earlier, the changing of the screens is a common maintenance task.

Q: At some point, though, you did change the screens?

A: Yes, the first time we changed screens Mr. Gilfoil (Salesman) was there, he brought the screens.

Q: Where are the screens located?

A: Up on top of the screen box.

Q: How did you get to the screen box?

A: Climbed up the belt.

Q: What was he standing on when he was showing how to change the screen?

A: The platform.

Figure 1: Extec Screening Machine

Q: How did you come to the understanding it was a platform to be used to change screens?

A: Well, that's where you have to be to do the work on the bolts that hold the screen in as was as adjusting the screens, that's where Gilfoil stood when he changed the screens originally. Its pretty much common sense looking at it you know you have to be at that position. The platform is there, it is made out of diamond plate steel, which that's what they use normally that you stand on if you are standing on steel. I think it serves two purposes a work platform to do the work on the screen box as well as to hold the tail conveyor.

Q: Did you ever use a harness to affix yourself?

A: no

Q: Did you ever see one at the O'Connor Brother Shop?

A: No

From this excerpt, it is important to note that Mr. Bartow claims Mr. Gilfoil showed him how to change and access the screens on the Extec machine. Mr. Bartow also mentions that Mr. Gilfoil used the conveyor belt to reach the platform in order to change the screen. He also admits to using a ladder to lift him self up to the platform however stated that only used these approaches. Lastly he states that he had never used nor seen a safety harness (for the Extec machine) throughout his employment with the O'Connor Brothers.

Later in the deposition, the questioner asks Mr. Bartow how he went about tightening the bolts used to hold down the screens. Mr. Bartow explains how he used a ¾ inch ratchet to do the job. Mr. Bartow claims that he would then use his foot to kick the ratchet, in order torque the bolts down until they were tight enough to operate. When asked about how many times he changed the screens, he answered approximately 50 times. This leads to the conclusion that Mr. Bartow had experience with this type of maintenance task.

Next, the deposition attempts to investigate into the morning of the accident. Mr. Bartow discusses what he remembers from that morning. According to Mr. Bartow, he climbed up the conveyor to reach the platform (in order to tighten the nuts that held down the screen). When he reached the platform, he began by tightening the left nut first. He then went to tighten the right lower nut. This is when his fall occurred. Mr. Bartow stated that his left foot slipped off the ratchet, he lost his balance, and fell. When his foot slipped out from under him he ended up falling headfirst to the ground. He managed to injure his head, shoulder, and back. Mr. Bartow estimated his fall being between 18 to 20 feet. When questioned about the weather conditions that morning, as far as ice and snow go, he said that there was no ice on the platform that could have caused his slip.

Upon reading the deposition of Kenneth Bartow, one might conclude that Mr. Bartow should receive workman's compensation for his accident. However, some of Bartow's fellow employees' depositions (below) seem to contradict Mr. Bartow deposition. According to these other depositions, Mr. Bartow lied about several of his statements. There is also evidence in these depositions that Mr. Bartow did not use the conveyor to reach the platform. Instead, he used a specially fabricated ladder to reach the platform. This in turn would significantly change the outcome of this case.

4.2.1 Deposition of Richard K. Bassett

Mr. Basset, an employee of the O'Connor Brothers Inc., is a mechanic for the company. According to Mr. Basset himself, he is in charge of maintaining everything the O'Connor Brothers owns and operates. In fact, Mr. Bassett has a good understanding of how to operate and maintain the screen machine involved in this case. In his deposition, Mr. Basset testified that he used a loader to reach the screen platform when tightening the screen's bolts. The following segment was taken directly out of Mr. Basset's deposition.

Q: Did you ever see Mr. Bartow walk up the main conveyor?

A: To go to the top?

Q: Yes.

A: No.

Mr. Basset also describes a modification that they added to the screen machine. In order to keep the snow off of the belts they covered the main conveyor with plywood. This would allow Mr. Bartow to use the machine without having to worry about frost or snow affecting the machine. However, with the addition of this cover, there was no way anyone could reach the top platform via the main belt.

Mr. Bassett was also asked by Mr. Bartow to fabricate ladder. At this time, Mr. Bassett was unaware of how the ladder was to be used. Later in his deposition, Mr.

Bassett testified that he had seen Mr. Bartow use the ladder as a modification on the screen machine (see Figure 2).

Figure 2: Ladder on Extec Screening Machine

Lastly, Mr. Basset was asked to state how he would go about changing the screens on the Extec Machine. The following excerpt is taken from his deposition:

Q: How do you tighten bolts when you do not use the air gun, but when you use the ratchet?

A: I usually kneel or sit down and pull down on the ratchet.

Q: Did you ever use your foot?

A: No.

Q: Would you think it to be safe to have the ratchet handle extending out to one of the sides of the frame and pushing on it with your foot?

A: No.

4.2.2 Deposition of Harold D. Green

Mr. Green, an employee of the O'Connor Brothers, is a truck driver for the company. He is the employee who found Mr. Bartow shortly after his accident. He begins his deposition with a description of how he exactly found Mr. Bartow. Basically, Mr. Green, after delivering a load to Sharon, MA, came back to the construction site and discovered Mr. Bartow on the ground near a sand pile. According to Green, "His [Mr. Bartow's] feet were headed towards the machine, but he wasn't really anywhere near the machine. He was probably, oh, 15 feet away from the machine, out to the edge of the sand pile. His ratchet was oh, probably 6 to 8 feet away from him down on the ground by his feet."

Mr. Green also concurred with Mr. Basset's deposition as far as how they would reach the screens. Mr. Green stated that they would have one man operate a "loader". That man would raise the loader enough for the other man to reach the platform to make the necessary adjustments.

When asked about a ladder being attached to the screen machine, Mr. Green stated that there was definitely a ladder attached. He figured that Mr. Bartow used it to reach the platform in order to replace the screens. He also stated that he found Mr. Bartow on the side of the machine where the ladder would have been placed if used. The ladder was built to attach to the belt guard.

Mr. Green also stated that it was very cold the morning that the incident occurred. He claimed that the machine was covered in frost when he was at the scene at approximately 7:00 A.M. He also stated that the frost would make the machine and ladder more slippery than normal.

4.3 Investigation and Analysis

The main question of this case is: How did Mr. Bartow manage to fall off of the machine and get injured? Well, there are several options. First, one could believe Mr. Bartow's deposition. It pertains to him falling from the platform while tightening the screen bolts. However, a good engineer in the courtroom knows enough to not go by hear say. Engineers must reconstruct the scene of the accident in order to fully understand what really happened.

In this case, as in most, we have several stories/opinions in the form of depositions. One story being that Mr. Bartow fell off of the platform and the other that Mr. Bartow fell off the ladder, which was a modification to the machine. Let us begin by evaluating the first scenario, falling off the platform. Below in Figure 3, there are two pictures with measurements. These measurements would work, if in fact, Mr. Bartow had fallen off of the platform. The cone depicts where Mr. Bartow's body was when Mr. Green had found him.

Figure 3: Measurements From Fall Off of Screening Machine's Platform

In order to find if this fall is physically possible, several calculations must be made. There are several constants when discussing this case. The vertical height of the platform was 12.4 feet. We also know that gravity is 32 feet per second. With these two crucial pieces of evidence we can begin to piece together the case. In order to solve this problem, we will need to use some basic physics equations dealing with projectile motion: Dx = V*T and Dy = (1/2)*G*T^2. X equals the horizontal distance while Y is the vertical distance. With these figures and equations we can find Mr. Bartow's velocity, and see if the answers are feasible.

From the platform, we know Mr. Bartow's feet were at 12.4 feet. We must first solve for T (Time) in order to solve Vy, or horizontal velocity. Below is the calculation of T:

T= (2*(Dy/g)^1/2) or T = (2*12.4/32)^1/2 = 0.8803 s

Vy = Dy/T = 12.4/.8803 = 14.08 ft/s

Figure 4: Measurements from Fall Off of Screening Machine's Ladder

We can now use the same basic principals to calculate Mr. Bartow's fall from the ladder. The only difference between these two scenarios would be the height of the fall.

For the ladder, we know Mr. Bartow's feet were at approximately 9 feet from the machine. We must first solve for T (Time) in order to solve Vy, or horizontal velocity, hence below is the calculation of T.

T= (2*(Dy/g)^1/2) or T = (2*9/32)^1/2 = 0.75 s

Vy = Dy/T = 9/.75= 12 ft/s

4.4 Final Assessment

After evaluating the calculations, one realizes that it was more plausible that Mr. Bartow fell off of the ladder than off the machine's platform. By taking his Vy (horizontal velocity) of 14.08 and multiplying it by the fall time of 0.88 you get a total distance of 13 feet away from the machine. Now if you do the same calculations for the ladder scenario, his total distance equals 9 feet.

According to Mr. Green's deposition, Mr. Bartow's feet were approximately 8 feet away from the edge of the screen machine. The ladder calculation of 9 feet seems to be closer to Mr. Green's deposition than that of the calculated fall off the platform.

Mr. Bartow's body was positioned with his feet toward the machine. In order for Mr. Bartow's story to hold true, he must have been quite the acrobat. It is almost impossible to imagine a person falling and landing in such a manner. If Mr. Bartow fell head first, he would also have had to do a flip in mid air, in order to land as depicted by Mr. Green.

Mr. Bartow also stated that there was no frost or snow on the machine the morning of the incident. However, Mr. Green stated that morning was extremely cold and frost was apparent all over the machine. This is just another example of Mr. Bartow's faulty creditability.

In this case, there are three parties that could be held accountable. Extec Screen & Crushers LTD, the O'Connor Brothers Inc., or Kenneth Bartow. Extec Screen & Crushers LTD could be held liable for not making the machine safe enough, i.e. not providing a safety harness for making screen adjustments. The O'Connor Brothers could be held responsible for their lack of safety revisions. Lastly, Kenneth Bartow could be held accountable for his own actions of modifying the Extec machine with a ladder.

We will first evaluate the role Extec Screen & Crushers LTD played in this case. Mr. Bartow's case holds Extec liable for various reasons. The following is a list of the different claims Mr. Bartow has brought on Extec:

Type of Claim	Amount of Money
Negligence	*$2,500,000*
Breach of Implied Warranty of Merchantability	*$2,500,000*
Breach of Express Warranty	*$2,500,000*

Breach of Implied Warranty of Fitness For a Particular Purpose	*$2,500,000*
Loss of Consortium – Wife	*$1,000,000*
Loss of Consortium – Son	*$750,000*
Total	***$11,750,000***

As stated earlier, Mr. Bartow was injured while working on an Extec Screen Machine. Mr. Bartow stated that if the machine had a railing around the platform, then he would not have fallen off. In this respect, Mr. Bartow has a good point. However, should a portable screen machine be outfitted with such excessive safety precautions? This is a judgment call by the manufacturers of the machine. Extec designed the machine to be portable, not idiot proof.

We do not believe Extec is liable for their actions. This scenario is similar to that of a roofer. When a roofer is up on a roof laying shingles, do they enclose the entire roof with safety rails? Of course not, a roofer just takes the proper precautions while performing his job. In turn, we feel the same way with Kenneth Bartow. It was his responsibility or his company's responsibility to properly safeguard the machine used at work.

This leads us to the next party involved: the O'Connor Brothers. Should the O'Connor Brothers be held liable for the accident? They very well could be held liable for the fact that they did not provide the proper safety restraints while working on the job. Mr. Bartow never knew a safety harness existed, even though there was one located in the tool shed. According to the Lexis Law Publishing Code of Federal Regulations, relating to workplace safety, employers are supposed to provide full fall protection when employees are working at heights of 6 feet and above. The O'Connor Brothers failed to complete this task at hand. However, the O'Connor Brothers were covered by Workman's Compensation Insurance. This protects the company from any lawsuits brought upon by employees.

The last subject to look upon in this case is the plaintiff, Kenneth Bartow. Mr. Bartow used bad judgment on the morning of the accident. First of all, the machine was entirely covered with frost. Mr. Bartow should have known enough not to attempt to tighten the screen by himself in these circumstances. Secondly, Mr. Bartow most likely altered the machine to access the platform. Mr. Bartow had Kenneth Bassett design and fabricate a ladder. According to Mr. Green, Mr. Bartow used the ladder to access the platform. Mr. Bartow never asked Extec if this was an acceptable modification. Lastly, Mr. Bartow should have had enough common sense to obtain or ask for some sort of safety device to assist in this type of maintenance of the machine.

After researching the case in depth, we have come to the conclusion that Extec Screen & Crushers Ltd. should not be held liable for the injuries of Kenneth R. Bartow. Even though Extec did not supply the proper safety rails, industry standards for portable screen machines at the time did not require safety rails. These machines are built to be as portable and mobile as possible. Safety precautions in the industry are left up to the discretion of the manufacturer. We feel that Mr. Bartow would have had a better case against the O'Connor Brothers. However, the O'Connor Brothers were covered by Workman's Compensation Insurance, which protects them from any suits brought forth by employees. All and all, Mr. Bartow was liable for his own misjudgment. He should not have attempted to perform any maintenance on the screen machine the morning of December 16, 1994 with the assistance of another employee.

5 Bruce S. Perkins V. Eric J. Rodgers

5.1 Background

On the night of September 3, 1999 at approximately 6:45 PM the two parties involved, Mr. Bruce S. Perkins and Mr. Eric J. Rodgers, collided on Rte. 101 in Milford, New Hampshire. The accident took place in front of Elisha's Restaurant, where Mr. Rodgers had gone to relax and eat with his father. As Mr. Rodgers attempted to exit the parking lot, making a left-hand turn or west bound on 101A, Mr. Perkins, who was driving a motorcycle traveling Eastbound on 101A, hit him. Mr. Rodgers was driving a 1999 Mercury Sable while Mr. Perkins was driving a custom built 1996 Harley Davidson Motorcycle. After the accident occurred, Mr. Rodgers Car was facing Elshisa's parking lot with his damaged fender facing the opposite direction of the collision. Mr. Perkins motorcycle was in the west bound lane, where it had settled after the impact (see Figure 5). Fortunately, there was a single eyewitness who viewed the entire accident from the rear view mirror of his car. Mr. Steve R. Neil was allegedly driving in front of Mr. Perkins heading eastbound on 101A.

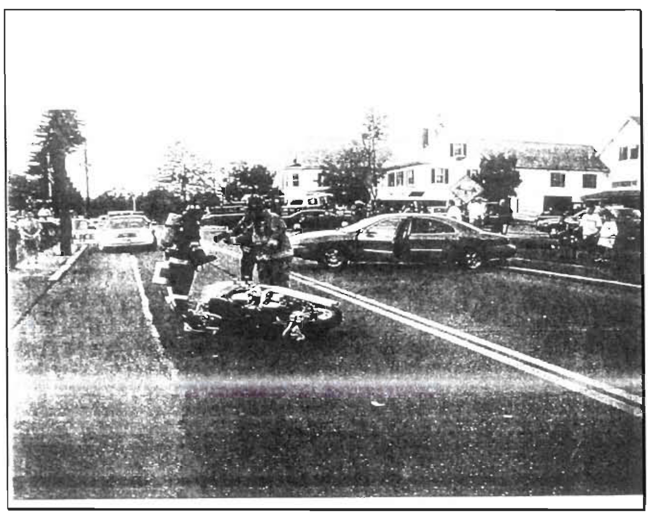

Figure 5: Bruce Perkins's Motorcycle After Accident

5.1.1 Police Report

Officer Miller was the first law enforcement official to arrive at the scene of the accident. The ambulance and fire department had already arrived to the scene ahead of him. When he arrived at the scene he observed several, crucial pieces of evidence:

1. Mr. Perkins had several road abrasions, such as cuts and scratches all over his body.
2. There was a long skid mark that existed in the roadway, due to a high rate of speed. It led to the point of impact on Mr. Rodger's car.
3. The skid mark was on the far-left side of the lane.
4. There was a strong smell of alcohol on the motorcyclist's breath, possible intoxication.
5. The motorcyclist quite possibly could have been able to maneuver around Mr. Rodger's vehicle.

Officer Frye interviewed the first witness, Steve R. Neil, whom was in front of Mr. Perkins heading Eastbound on 101A. According to Mr. Neil, he witnessed the accident from his rear view mirror. The following paragraphs are Steve Neil's words describing the accident.

"As we drove, a 2000 Silver Neon, past a blue house located on 101A, Amherst St, the motorcycle driver revved up his Harley and sped out from the driveway at an aggressive rate of speed. I looked in the rear view mirror because of the loud noise coming from the motorcycle and continued to drive east on 101A. I kept a look on the motorcycle in the rear view mirror. As I looked back on the road I noticed the, Tan/Gold/Mustard colored Chrysler waiting at the Elisha's exit/entrance. He seemed impatient, I commented to my wife as we drove by. Realizing the possibility of an accident I glanced back in my mirror to watch the motorcyclist drive by. Right at that moment I saw the Chrysler pull out, the motorcyclist skid, also the tires skid, and hit the Chrysler spinning it 180 degrees. We immediately pulled over to the side of the road and called 911."

Officer Frye also added, "Steve told me he observed the motorcycle traveling behind him from his rear view mirror, and told me he felt the motorcycle should have been able to go around the gold car. He said I don't know why he didn't make it. He also recommended that the motorcycle was in second gear. I asked Steve how fast he felt the bike was traveling at, and he said at least 65 mph."

The issue of alcohol consumption was also raised. Detective Chovanec told Officer Harwick that the odor of an alcoholic beverage was apparent on Mr.Bruce's breath. Mr. Bruce stated that he consumed two beers. Officer Frye then told Bruce he was under arrest for driving under the influence of intoxicating liquor and read him his Miranda rights. Mr. Bruce refused to take a blood alcohol test, so Officer Frye read him his rights again, checked off the box refusing the requested testing (on the accident report form), and signed the form accordingly.

There were also several measurements taken at the scene by Officers Frye and Tiller (see Figure 6). These measurements became detrimental in the use of proving Mr. Perkins actual speed at the time of the accident. A key element in this case that will later be discussed in more detail was Mr. Bruce's skid mark. The police report, as listed below in figure 2, states that the skid mark was 106.6 feet in length.

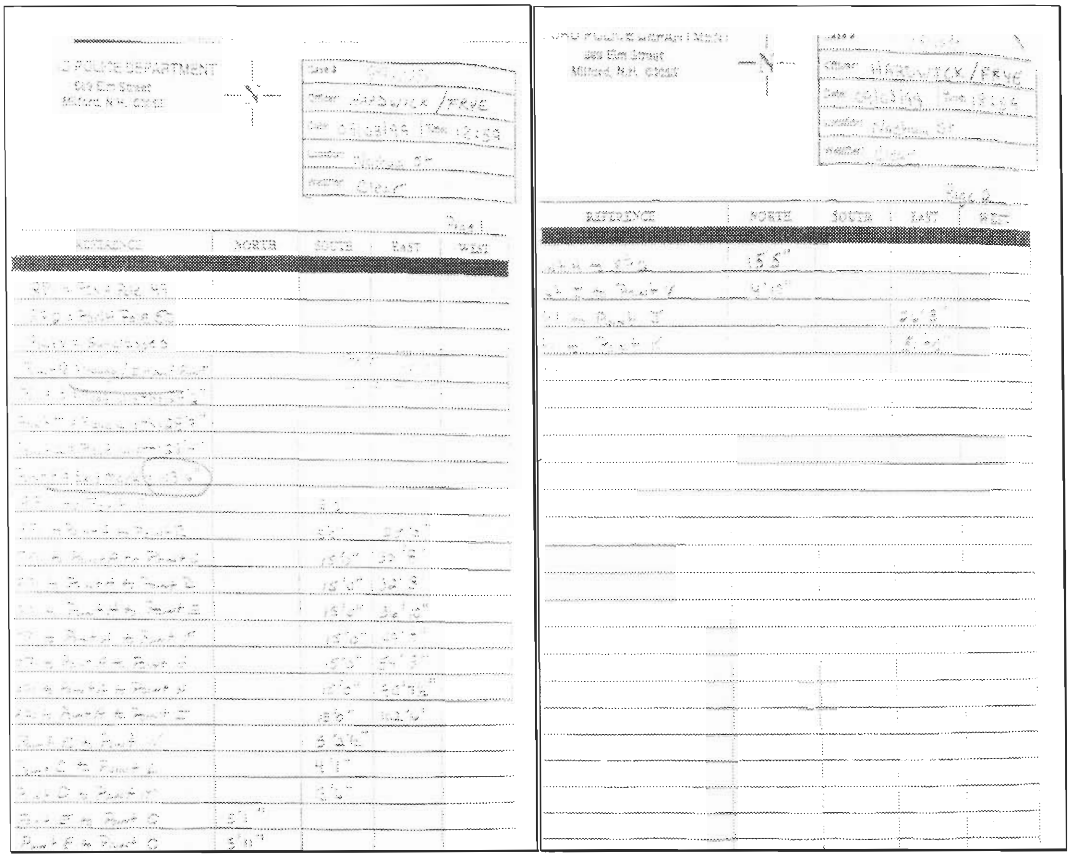

Figure 6: Police Report of Perkins v. Rodgers

5.2 General Accident Description

<u>5.2.1 Interrogation/Deposition of Eric J. Rodgers</u>

The depositions become a crucial tool when involved in such a suit. It gives the individuals involved to understanding of what exactly was going through the opposing sides head. It also allows for each side to speak of how exactly the "story" took place from their perspective.

In the deposition of Eric J. Rodgers, a new twist evolves in the case. The police reports contain limited amounts of information, hence the need to interview both sides of the case.

In the interrogation, we finally get to hear Mr. Rodgers side of the story, below is a piece of the interrogation where Mr. Rodgers is questioned as to what happened that evening. In this interrogation, "Q" represents the interrogator's (police officer's) question, while "A" represents Mr. Rodgers answer.

Q: State in your own words the precise manner in which you assert the accident you were involved with Mr. Perkins occurred. Specify speed, position, direction and location...

A: I stopped at the edge of the parking lot for Elisha's Restaurant and let two cars pass by. I looked both ways for traffic and did not see any cars coming. I pulled out intending to make a left hand turn. As I did so I saw a blur coming from my left with my peripheral vision. I did not have time to do anything as the impact that followed in an instant after seeing the blur coming. Mr. Perkins motorcycle hit the driver's side of my car near the rear tire. The impact was sufficient to cause my air bags to deploy and to spin my car around so that I was facing back where I had come from.

Q: Please state the distance in feet that you had a clear view of the plaintiff's vehicle prior to the collision as the plaintiff's vehicle was approaching the point of the collision...

A: I cannot tell you; because the accident happened virtually at the time I became aware of him. I had good visibility with the exception of some blind spots created by telephone poles

Q: Where there any objects that obstructed your view

A: Just the telephone poles to my left

Q: Could you do anything to avoid the accident you were involved in with Mr. Perkins

A: I looked carefully as I could but once I saw Mr. Perkins coming I simply had no time to react

Q: Did you consume any alcoholic beverages of any type or any sedative, drug...

A: I had a few beers at Elisha's. I do not recall the exact times or the number of beers.

Q: If the brakes in your car were applied at any time prior to the collision...

A: I did not have time to brake from the moment I saw Mr. Perkins.

Q: If the accelerator was applied at any time prior to the collisions...

A: I was accelerating at a normal pace from the parking lot; I do not know my exact speed or the distances involved.

Q: State your speed at these points: 50 yards prior to impact, 25 yards prior to impact, and at impact.

A: Stopped, Stopped, less then 5.

Now we establish the fact the Mr. Rodgers also had a few alcoholic beverages prior to the incident. Mr. Rodgers also discussed an obstruction in his view. This obstruction was caused by a pair of telephone poles located close to the left of the exit. Mr. Rodgers, attempting to make a left hand turn, had to look toward these poles that obstructed his view (see Figure 7).

Figure 7: Lot View of 101A from Elisha's Restaurant

The next segment of questioning also comes from Mr. Rodgers deposition. In the deposition we receive a more in-depth view of what happened.

Q: What type of car were you driving?

A: Mercury Sable '99 (car had approx. 6000 miles on it and was inspected in June of '99)

Q: Do you wear glasses?

A: No (No eye problems at all)

Q: You are familiar with that area

A: Yes (had been they're many times)

Q: What did you do at Elisha's?

A: Had a few beers, had something to eat, and had a good time…left

Mr. Rodgers then states that he drank 4-5 beers with his appetizer, all within an hour and a half. This may seem like quite a few for the amount of time he was present at Elisha's, however later in the deposition we are told that Mr. Rodgers weighs around 240-250 pounds. Mr. Rodgers then again explains his accident in more detail. This is a brief interpretation of the questioning that took place.

Mr. Rodgers was exiting the parking lot on the Nashua side of the parking lot. There were no cars coming from the Nashua side going the other way. He was making a left-hand turn to go back towards Milford, NH. He looked to the right then the left then back to the right then pulled out. There were several poles blocking his view towards the left. He describes the accident as a "blur." As he pulled out of the lot, he got hit and the air bags deployed. Mr. Rodgers claims that it was instantaneous as far as the collision goes. "I didn't see him until he was within feet of my car."

Again, the issue of the utility poles is brought up. Figure 7 refers to the view Mr. Rodgers would have had when exiting Elisha's. As you can see, the poles are staggered; one pole after another obstructs your view. However, in-between these poles it is easy to see 100-120 feet east down 101A of this exit.

5.2.2 Deposition of Mr. Perkins

The following deposition is that of Mr. Perkins. We can now get a better understanding of what was going through his head as he approached Elisha's parking lot exit. Mr. Perkins, at the time, was driving a 1996 custom-built Harley Davidson. Mr. Perkins stretches the truth a bit in one section of his deposition, as you will see. The following is a section of Mr. Perkins Deposition. Once again, Q is the question asked by the questioner and A is the answer that Mr. Perkins gives.

Q: How would you describe your health prior to September 3, 1999 (accident)

A: Fine had no problems

Q: Tell me the injuries you received from this accident.

A:
1.Sustained a head injury from my forehead to the middle of my scalp.
2. Eyelid was bruised where my sunglasses had hit it (left eye).
3. Neck was thrown to left pulling all muscles through my shoulder.
4. Left knee got pretty well banged up and swollen down the entire leg to the ankle.
5. The front end of the motorcycle came right around and crushed my foot.

Q: How did the accident happen?

A: I had just pulled out of my driveway. Pulled out behind a car that was headed east. He passed. I pulled out behind him. I was approaching Elisha's. I first noticed two cars coming from the west—headed west just before the exit of where Mr. Rodgers came out. The car in front of me was getting close to Mr. Rodgers or the exit.

I saw Mr. Rogers completing his maneuver across the parking lot and maybe the last thirty or so feet pulling up to the roadside. He stopped. The two cars that were headed west had passed. And he went to—kind of looked like he was going to pull out, because his car did that almost take off and jerk. You know, the gas, brake, jerk. And that was when the car in front of me was passing him.

It looked like he was either—he wasn't—he didn't see him. My second thought was that if it was—he saw him, but he didn't see me. And as soon as the car in front of me, it was Stephen Neil, pulled passed him, he pulled out. I saw his face in a big surprise. He was maybe a little less then half in my lane. At that point I had gone--- I had locked my brakes up. And I remember saying or thinking got myself, don't pull out, just sit still or back up.

I had plenty of room to go right pass the front of him. I was half or better in my lane to go pass him. At that point, I see some other cars coming from the west before that exit. I didn't want to get in their lane to hit them. And at the last second, he just nailed it to get where he was going to the left. I tried to do a hard right. And I hit him in his rear quarter right about his tire.

Mr. Perkins then stated that he was traveling at 30-35 MPH, which he describes was average in the area, even though the posted speed limit is 25 MPH. He then talks about he measured the distance of his skid. Mr. Perkins claimed that his skid was only 50-60 feet long as compared to the police listing of over 100 feet. Mr. Perkins then said that he was approximately 60-75 feet away from the exit before traffic was clear for Mr. Rodgers to complete his maneuver. When he was approximately 100 ft from the exit he noticed Mr. Rodgers looked as if he was going pull out. He began to veer off to the left.

5.3 Investigation and Analysis

No matter what side you are working for, you must uphold the truth in order to keep your professional integrity. A good engineer will examine the case and pick apart the fact from fiction, with the application of science and technology.

In this circumstance, we must look at several areas. One, what was Mr. Perkins speed? We have heard both sides of the case, however neither side agrees. There is a witness who claims Mr. Perkins was driving at close to 65 MPH, while Mr. Perkins states he was driving at the most 30-35 MPH. When the witness's approximation varies by this large of an amount, it is time to use physics to calculate the answer.

After doing some research on the Internet, we were able to obtain two key elements in finding Mr. Bruce's actual speed. One key being the formula for calculating speed, and secondly, the coefficient of friction between rubber and dry pavement. Below is the actual formula we encountered on the Internet:

The Square root of the sum of: 30 x d x f will equal the vehicle's speed calculated from skid marks. Where S= speed 30 is a constant, d = distance of skid, and f = coefficient of friction or drag factor.

http://www.pimall.com/nais/n.skidm.html

The distance is given to us from the police report. However, the coefficient of friction between rubber and dry pavement was not given. Through the proper research, we discovered that the coefficient of friction between a tire and a dry paved surface was 0.7. Figure 8, listed below, is a description of how this value can be found.

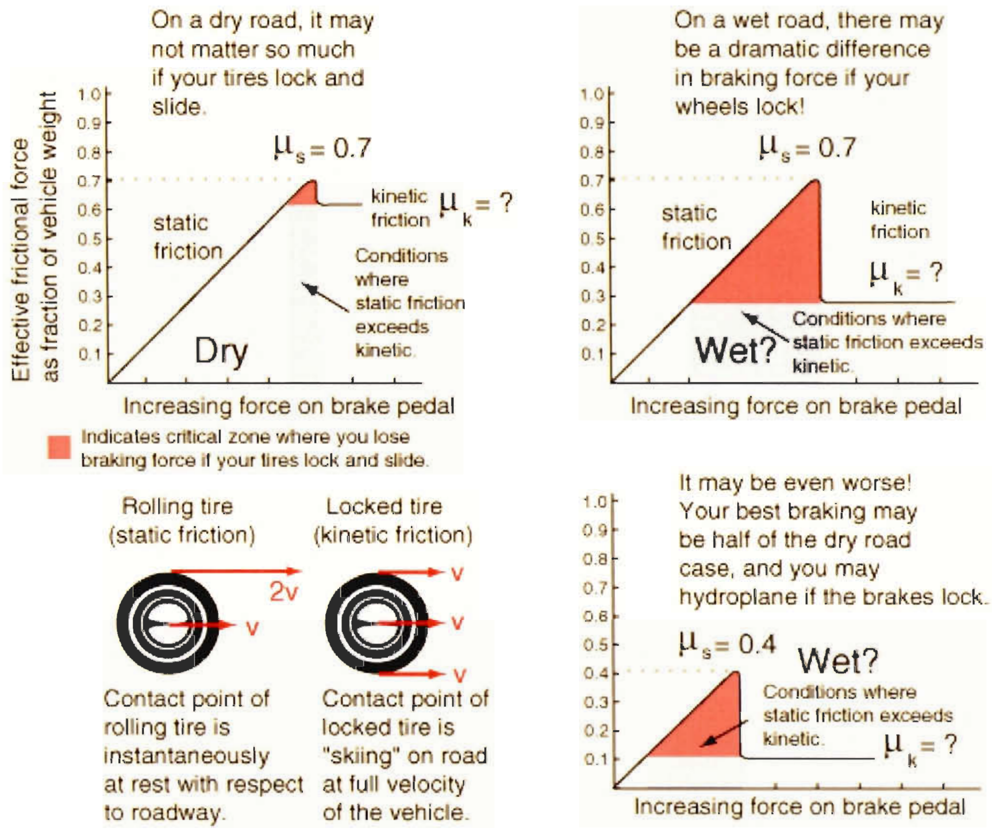

Figure 8: Coefficient of Friction

http://hyperphysics.phy-astr.gsu.edu/hbase/mechanics/frictire.html

Two different speeds can be calculated from this equation. One, Mr. Perkins speed if we use the police report's skid mark length of 103.6 feet. Or Second, Mr. Perkins's speed if we use his estimated length of 56 feet. If we take the square root of (30*103.6*.7), we discover that Mr. Perkins speed was approximately 46.5 MPH. If we take the same equation and use the distance of 56 feet instead of 103.6 feet, we get a speed of 34.29 MPH. Both of these speeds are above the legal limit posted in the area, which was 25 MPH.

Next, we must evaluate Mr. Rodgers situation. He explains how staggered utility poles were obstructing his view. A good engineer will go to the site and re-trace the steps of the individuals involved. In fact, we obtained photos from the scene of the accident. It is clearly portrayed in Figure 7 that a motorcycle could be blocked from Mr. Rodger's line of sight. This situation could certainly be exacerbated the motorcycle was traveling over the posted speed limit.

5.4 Final Assessment

Seeing that both Mr. Perkins and Mr. Rodgers had consumed alcohol, both parties could face charges of Driving while Under the Influence (DUI) of alcohol in the state of New Hampshire. To some extent, both sides are equally as guilty in this area. However, according to our calculations, Mr. Perkins was breaking the speed limit in excess of at least 20 MPH. Even if we considered Mr. Perkins's own measurement of the skid mark, it would show that he was still traveling of the posted speed limit. Hence, we find that the courts cannot reward Mr. Perkins any sort of compensation for his injuries on behalf of Mr. Rodgers.

6 Vermont Yankee Nuclear Power Corporation v. Cianbro Corporation v. Rodney Hunt Corporation

6.1 Description of Sluice Gates and their General Operation

A sluice gate is a cast iron, vertically sliding valve having bronze seating surfaces and adjustable bronze wedges. (Refer to Figure 8) It is used at the end of a pipeline or to cover an opening in a wall and is not an in-line valve. Sluice gates are raised and lowered by means of stems or rods using manually operated screw stem hoists, electrically driven screw stem hoists or hydraulic cylinders. Sluice gates are mounted to a wall casting or thimble embedded in the concrete, a pipe flange or mounted directly to the concrete wall with anchor bolts.

Sluice gates have been used in controlling water and sewage for 75 years. They have the important advantage of having an extremely long life with very low maintenance. Once a sluice gate has been properly installed, its normal life will be 30 to 50 years and no maintenance of the gate itself will be required. Simple periodic cleaning and lubricating of the stem and hoisting mechanism are all that is required over the life of the gate installation. Very few pieces of equipment used in water control are as reliable, long lasting and as maintenance free as the cast iron, bronze mounted sluice gate.

Figure 8: Sluice Gate at Vermont Yankee Nuclear Power Corporation

There are a large number of variations of sluice gates. They can be furnished with conventional closure with bronze seats completely around the periphery or with a resilient seal across the bottom of the gate for flush bottom closure.

In the normal gate, the operating thrust is taken on the floor or a separate support above the gate. All sluice gates can be furnished as self-contained gates in which the operating device is mounted on the yoke of the gate, which is, in turn, attached to the top of the guides. On these gates, the operating thrust is taken by the gate itself.

Most sluice gate applications use a rising stem in which the threads are at the operator and the stem moves up and down with the gate. It is possible, however, to provide sluice gates with non-rising stems. On these installations the threaded section of the stem is at the gate and the disc climbs the stem as the stem is turned. (Refer to Figure 9)

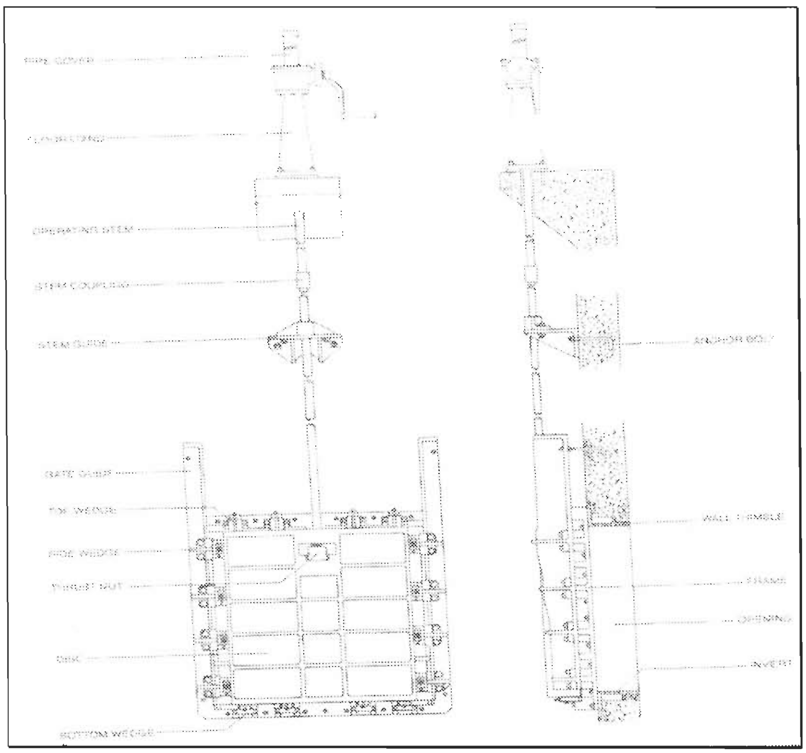

Figure 9: Cross Section of Sluice Gate

The largest practical size for a sluice gate measures 16ft. x 16ft. Sluice gates are made as small as 6 inches, but in these small sizes, other types of valves may be more practical.

6.2 Background

6.2.1 Description of Vermont Yankee Nuclear Power Plant

Vermont Yankee Nuclear Power Plant (Vermont Yankee) is located on the west shore of the Connecticut River in the town of Vernon, Vermont. The plant was constructed in the late 1960s. Vermont Yankee uses water from the Connecticut River for station heat removal. Water is pumped from an intake structure north of the plant, circulated through a main condenser and discharged back into the river south of the plant. During hot weather, two eleven cell cooling towers aid in heat dissipation. Depending upon river flow, pH and temperature, cooling water can be either 1) discharged directly to the river, 2) re-circulated through the cooling towers, or 3) circulated through cooling towers and then discharged to the river. The flow of water is controlled by two 11 ft wide by 13 ft high sluice gates, which are the subject of the arbitration proceedings.

6.2.2 Circulating Cooling Water System

The circulating cooling water system consists of an intake structure containing traveling screens and pumps, main condensers, cooling towers, a discharge structure (which contains circulation pumps and sluice gates), interconnecting piping, various valves and fixtures, and an after-bay which contains an overflow weir and energy dissipaters. Water from the condensers is discharged to the upper portion of the discharge structure. From this location, water can either be directed through the bypass gates to the after-bay or pumped to the cooling towers. From the after-bay, water can either be re-circulated to the intake structure or allowed to flow over the discharge weir and across a series of energy dissipaters before returning to the river. Discharge from the cooling towers enters the after-bay on the south wall through an opening approximately 10.5 ft tall by 25 ft wide and approximately 2 ft downstream of the south bypass gate. A portion of the cooling tower return flow is actually directed upstream towards the backside of the south bypass gate. There are three circulating pumps for the cooling towers, each rated at approximately 122,000 GPM. Under certain condition, over

300,000 GPM of cooling tower discharge may be directed towards the back of the bypass gates in the after-bay.

6.2.3 Modes of Operation

Vermont Yankee has described three modes of operation of the above system (Refer to Figure 10):

1. The open cycle in which water is pumped from the river through the condensers and returns to the river,
2. The closed cycle in which water is circulated through the cooling towers and only water to make up for evaporation and leakage is drawn from the river, and
3. The hybrid cycle, any combination of the two above modes where a portion of the cooling water is being re-circulated.

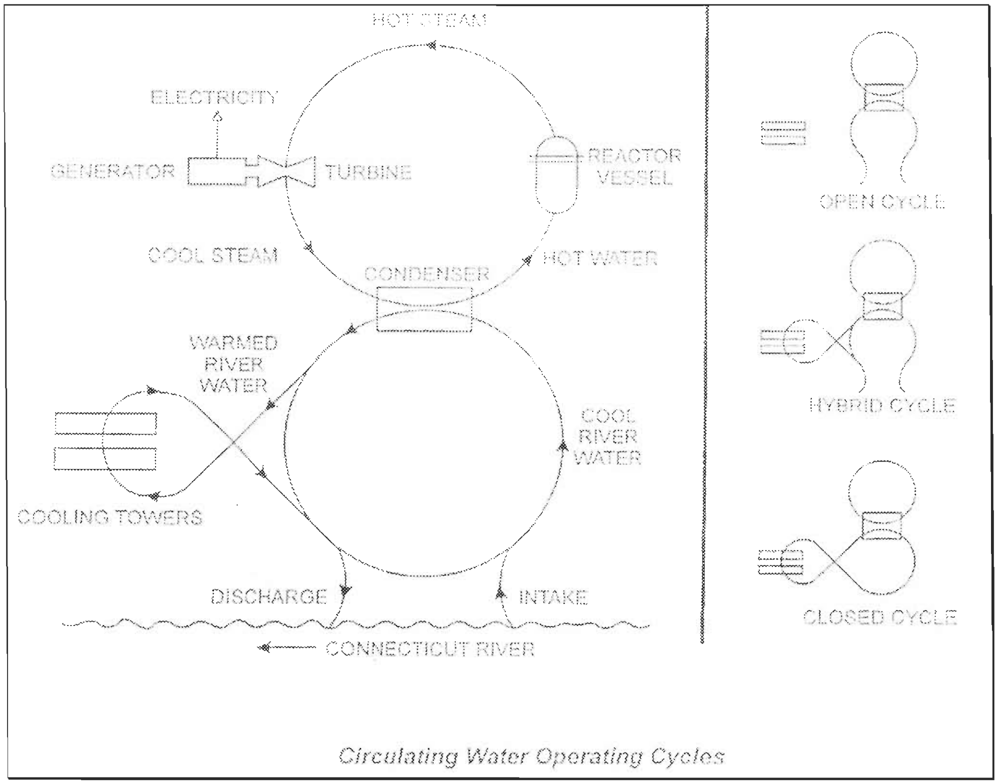

Figure 10: Circulating Water Operating Cycles

6.2.4 Circulating Water Bypass Gates

The primary control devices for the three modes of cooling water flow are the two bypass gates. These sluice gates, 11ft wide by 13 ft high, are mounted on the east wall of the discharge structure on the after-bay side. The gates are installed so as to perform under an unseating head. The gates are configured to operate in an inverted convention, that is, the gates move down to open and up to close. The original gates were manufactured by ARMCO to conform to a 1969 specification prepared by Ebasco. The gates were conventional cast iron sluice gates with bronze seating surfaces and wedges to assure positive sealing under an unseating head. It is understood that the original system had electric gate actuators, which were installed at a later date. Both actuator systems included a stem that projected vertically through the gate opening and was in the discharge stream when the gate was open. A stem guide was also mounted on the wall above the gate.

The gates are attached to a cast iron wall thimble, which is embedded in the concrete forming the gate opening. The original gates had an integral frame and guide system, which was bolted to the wall thimble to receive the moveable gate. The gate was guided through the range of travel by a cast iron tongue and groove detail. The tongue was on the movable gate disc and the groove was machined in to the guides.

6.3 Reasons for Arbitration

6.3.1 Vermont Yankee's Reasons for Arbitration

Vermont Yankee Nuclear Power Corporation made a claim against the Cianbro Corporation (Cianbro) arising out of Cianbro's performance under the Vermont Yankee contract/purchase order number 97-16510 issued February 27, 1998. The contract called for the supply and installation of two cast iron gates with bronze seat faces and bronze wedges (Gates) at Vermont Yankee's nuclear power electric generating plant located in Vernon, Vermont (Plant). Cianbro's liability is based on contract breach of warranty and the tort of negligent design, manufacture, and installation of the Gates. The Gates are an essential part of the Plant's Circulating Water/Cooling Tower System and critical to the safe and economic operation of the Plant. Vermont Yankee is the owner of the Plant. Under Contract, Cianbro was responsible for the design, manufacture and installation of the gates. Cianbro delegated the design and manufacture of the Gates to the Rodney Hunt Company (RHCo) but retained responsibility for Gate installation. Vermont Yankee also had a direct negligence claim against Rodney Hunt, which Cianbro sought to consolidate with this arbitration agreement.

Vermont Yankee submitted that the evidence would show the following: The Gates were installed and tested during Vermont Yankee's 1998 refueling outage and placed in service on May 28, 1998. The Gates failed within one year of operation. During an inspection on April 5, 1999, by a Rodney Hunt Field Service Technician, the South gate was discovered to be severely damaged and declared inoperable. Despite the fact that the gates were supposed to be heavy duty utility grade equipment, the gates were only operated 42 times in 1998 and 3 times in 1999 before the discovery of their failure in April of 1999, where an up stroke or a down stroke is considered one gate operation. On May 17, 1999, the North Gate was declared degraded and was tagged for "emergency use" only. Subsequent inspections found further damage to the North and South Gates. The North Gate had lost all gate tongue liners, many loose studs and bolts and separation of the upper and lower guide connection due to missing bolts. The South Gate suffered from sheared wedges, sheared bolts and studs, loose and missing bolts and nuts, missing bronze gate tongue liners, damage to the gate tongue, brass wear plates on the guides were missing and the sealing strip was damaged. The screws that held the tongue liners to the gate were all sheared off. In short, it was a significant failure, which, if not caught, could have resulted in a catastrophic failure of the discharge structure and shutdown of the Plant. (Refer to Figure 11 for damage of liner)

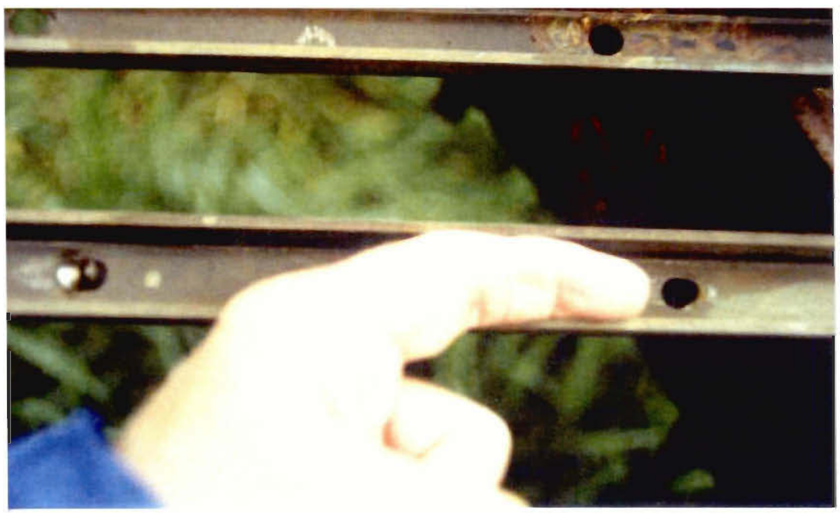

Figure 11: Damaged Tongue Liner

Due to the evidence above, Vermont Yankee had to take emergency gate operation and protection measures including the installation of a costly temporary concrete cofferdam. It also suffered lost generation, significant reductions in Plant operating efficiency and other economic penalties as a result of the Gate failures. According to Vermont Yankee, Cianbro's and Rodney Hunt's refusal to provide a satisfactory demonstration of contractually adequate repair or replacement forced Vermont Yankee to replace the Gates by purchasing and installing new gates.

The original discharge structure gates that the Cianbro Gates replaced were installed at the time of original Plant construction under identical technical requirements using the so-called "Ebasco Specification". The original gates had lasted for nearly 25 years without a substantial failure as occurred with the Cianbro Gates.

Vermont Yankee asserts that the Gates failed to meet the warranty requirements of the Contract and were negligently designed, manufactured, and installed. Vermont Yankee's contract claim is determined by whether Cianbro violated the warranty requirements of the Contract. Vermont Yankee's warranty claim is only against Cianbro, its direct contracting party under the Contract. Under Vermont law, Vermont Yankee also has a tort claim against both Cianbro and Rodney Hunt for the negligent design, manufacture and installation of the Gates. Cianbro has denied liability but has sought an indemnification/contribution claim against Rodney Hunt for any contract or tort liability that may be determined against it. Rodney Hunt denies liability under both contract and tort claims.

6.3.2 Contract Claims According to Vermont Yankee Nuclear Power Corporation

The Contract's primary warranty provision is in a document incorporated into the Contract by reference captioned "Vermont Yankee Nuclear Power Corporation – General Conditions – For Purchase of Services, Equipment and Materials", hereinafter the "General Conditions". The provision of primary interest is paragraph 15.b., which provides the following:

> "Contractor warrants that the Work shall conform to the specifications and requirements of the Contract; that the Work shall be free from defects in design, workmanship, material and performance, fit for Purchaser's intended purpose, and fully merchantable; and that the Work shall be new and not used or reconditioned."

Vermont Yankee asserts that the failure of the Gates is a breach of the Warranty Provision. Cianbro and Rodney Hunt challenge that assertion.

With this in mind, a brief comment regarding each relevant phrase of the Warranty Provision is set forth below. First, the Warranty Provision in part provides "that the Work shall conform to the specifications and requirements of the Contract. The contract specifications are largely set forth in Schedule A of the Contract. Of particular importance is the incorporation of a document and drawings identified as the "Ebasco Specification, Intake and Discharge Control Gates (VYNP-5920-CH6)", hereinafter the "Ebasco Specification". The Ebasco Specification was the same specification that was used for the original discharge structure gates, the gates that operated without failure for almost 25 years. The Ebasco Specification itself consists of seven pages and incorporates reference drawings, standards and guidelines. At a minimum, Cianbro had to build and install the gates to comply with the Ebasco Specification and Schedule A. The Ebasco Specification provides many important parameters for the gates (i.e. dimensions of the outlet structure and that they be made of iron) but it does not in fact provide a design. For example, Section 3 of the Ebasco Specification provides in pertinent part that "Liberal safety factors shall be used in the design of all the equipment." Similarly, Section 9 of the Ebasco Specification also provides in pertinent part that "All gate components will be designed to safely withstand the heads listed in the preceding sluice gate schedule." The Ebasco Specification also states the following:

> "All work shall be performed in accordance with the best modern practice for the manufacture of high-grade machinery. All parts shall have accurately machined mounting and bearing surfaces so that they can be assembled without fitting, chipping or re-machining. All parts shall conform accurately to the design dimensions and shall be free of all defects in workmanship or material that will impair their service. All attaching boltholes shall be accurately drilled to the layout as indicated on the drawings. The sluice gates and/or roller gates shall be completely shop-assembled to insure the proper fit and adjustment of all parts."

An analysis performed by Vermont Yankee after the Gate failures were discovered revealed several defects with respect to meeting the requirements of Schedule A and the Ebasco Specification. These defects were significant although not the sole contributors to the Gate failures. Vermont Yankee also provided several witnesses that testified to the technical requirements of the Contract and the Gates' failure to meet Schedule A and the Ebasco Specification.

6.3.3 The Cianbro Corporation's Response to Vermont Yankee's Claims

In response to Vermont Yankee's warranty claims, Cianbro's Nuclear Programs Manager, Robert W. Blackmore wrote a letter to Dave Bauer of Vermont Yankee. Blackmore's letter explained why Cianbro denied the warranty claim by Vermont Yankee against Purchase Order 97-16510-00. Cianbro denied the warranty claim bases on three factors. The first factor was Vermont Yankee's failure to communicate pre-existent adverse conditions. Those conditions being:

- Excessive turbulent flow induced vibration (Refer to Figure 12) and,
- Distortion of the existing ARMCO wall thimbles.

Figure 12: Excessive Turbulent Flow on VY Sluice Gate

The high vibration environment in which the gates were expected to operate was well known to Vermont Yankee and had caused significant damage to the previous ARMCO gates through the years. However, there were no attempts made in any of the contract documents to make the Contractor aware of this pre-existing condition.

In accordance with the contract documents, the replacement gates were required to be installed on the existing ARMCO wall thimbles. The replacement gates were installed in strict accordance with installation procedures that were either generated by or approved by Vermont Yankee. There were no provisions in the installation procedures to check for wall thimble distortion.

The second factor of Cianbro's denial of the warranty claim was Vermont Yankee's improper operational practices. These improper operational practices contributed to the gate failure and exacerbated the damage once the failure was initiated. These improper operation practices are as follows:

- Operating procedures were changed to compensate for an abnormal condition rather than to investigate and resolve the condition. The procedure changes were apparently not supported by any technical evaluation.
- The system was operated for an undetermined period of time in manual mode with all system protective devices disabled. No evidence could be found to indicate that any interim actions were taken to compensate for the loss of the protective devices and "Temporary Modification" controls apparently were not put in place.
- The gates were not monitored during operation, in spite of the fact that the procedures were newly revised and there were known problems with the operation.
- Although the gates were brand new and had experienced operational anomalies, operating records were not kept or maintained that were of sufficient quality as to be able to reconstruct the events leading to the failure.
- The system was operated in a mode that had been identified previously, in Vermont Yankee Event Report #96-0842, as not having received proper evaluation and being the most likely cause of excessive vibration that led to subsequent failure.
- The official gate report, "Evaluation of Discharge Gate Failure", VYM 99/158, was not received by the PORC or by any individual normally responsible for performing root cause evaluations.

The third factor of Cianbro's denial of the warranty claim was Vermont Yankee's failure to communicate operational problems in a timely fashion.

- When Vermont Yankee became aware of operational problems with the newly installed gates on May 31, 1998, they neglected to notify the contractor or the gate vendor. A period of 10 months elapsed before the gate vendor or Cianbro became aware that operational problems had been encountered. All the while, the gates were sustaining additional damage.
- When subsequent failure of the PCL power supply caused the HPU to become inoperable, Vermont Yankee again neglected to notify either the contractor or the gate vendor. While the HPU was inoperable, the gates had to be operated locally, with no system protective devices active, thereby potentially subjecting them to additional harm.

By electing not to notify the contractor of operational problems when they were first encountered, Vermont Yankee eliminated any opportunity the contractor had of effecting a timely repair before serious damage could occur. They further prevented the contractor from having the opportunity to take compensatory actions that would have mitigated the extent of the damage. See Figure 13 and 14 for "Vermont Yankee Gate Failure Matrix Comments".

Vermont Yankee Gate Failure Matrix				
CJN 217026				
Potential Failure Mode or Issue	Cognizant Org.	Why?	Probability	Comments
SS Screw Failure – Over-torque	RHCO	Screws were furnished and installed by RHCO	Low	See Note 1
SS Screw Failure – Wrong Material	RHCO	Screws furnished and installed by RHCO were a different type and of a different material than specified on their drawing.	Low	See Note 2
Excessive Vibration	VY	Screws may have loosened as a result of excessive vibration, caused by turbulent water flow impinging on the gates, particularly in the "Hybrid" mode of operation. Once loosened, the screws failed from the shear forces exerted upon them during the up and down movement of the gates.	High	See Note 3
Improper Operation	VY	VY experienced problems with the operation of the gates from the very first attempt to operate them, on May 31, 1998, following installation Unsuccessful attempts were made to increase the hydraulic operating pressure to the drive system, and ultimately the operating procedures were revised to modify the way the gates were operated	High	See note 4
Inadequate Specification/ Design	VY	The specifications for the design were insufficiently detailed to account for the turbulent flow and vibration conditions under which the sluice gates were required to operate. In addition, there is little evidence that the root cause of the damage sustained by the original ARMO gates over the years was ever determined and considered. The design and installation of the removable tongue covers was based on empirical data and experience	Moderate	See Note 5
Performance Specification	Cianbro	VY contends that contract language Makes Cianbro responsible for the performance of the gates under any and all circumstances.	Moderate	See Note 6
Repair Plan	Cianbro/RHCO	VY rejected the repair plan that was submitted on 6/30/99, and a decision was made at that time by VY to procure new gates from another vendor.	N/A	See Note 7

Figure 13: VY Matrix for Sluice Gate Failure

Potential Failure Mode or Issue	Responsibility	Why?	Probability	Comments
Improper Installation	Cianbro/VY/ RHCO	Cianbro was responsible to ensure that the installation procedures were followed properly, and that all post installation testing was performed satisfactorily. The installation procedures used for installation were provided by VY and RHCO.	Low	Installation procedures provided by VY Engineering and RHCO were part of the PMP and followed by the crew. All vendor procedures are reviewed and approved by VY. The expectation of VY is that the contractor will follow the procedures
Existing Wall Thimble Distortion	Cianbro/VY	The contract documents required that the new gates be installed on the existing wall thimbles. Installation procedures provided by VY and RHCO had no provisions for checking trueness of thimble	Moderate	See Note 8
Failure to provide timely notification of a problem with gate operation	VY	Failure to provide notification of an operational problem for almost a year after it was first encountered precluded either Cianbro or RHCO from having any opportunity to correct the problem or to take compensatory actions to minimize the damage.	High	See Note 9

Figure 14: VY Matrix for Sluice Gate Failure

6.4 General Accident Description

A memo from the Mechanical/Structural Design Engineering Supervisor at Vermont Yankee, Robert Oliver, to James Callaghan on February 15, 2000 provides the comments on the meetings with Cianbro, Rodney Hunt and Vermont Yankee regarding the discharge gate failure. This memo included what Vermont Yankee and Cianbro both agreed caused the gate failure. Both parties agree that the screws failed and the bronze tongue covers fell off. However, what caused the screws to fail is a subject that both parties disagree on. The conclusion of the memo states "there may be some differences of opinion on how the gates were operated or how the gates were installed, but the use of inappropriate screws allowed the tongue liners to become loose, thereby causing a cascading effect that resulted in gate failure."

However, Attachment A of this memo provides other evidence and issues not mentioned in the conclusion of the memo. One crucial issue, not in the conclusion, was the flatness of the embedded wall thimble. The vendor that supplied the new gates (in 1999) noticed that there was a small gap between the "J" seal and the gate when he was standing in the after –bay of the Discharge Structure. It should be noted that these gates are of a different design than the cast iron gates supplied in 1998. This vendor strung cross lines from bolts that project from the embedded wall thimble and found that there was a gap of approximately 1/8 inch between the diagonals. The attachment of the string lines was to the threads on the studs that extended through the new gate from the thimble. Thus the information obtained from the stringing of diagonals may be used to infer that there were no gross out-of plane errors in the wall thimble.

6.5 Investigation and Analysis

6.5.1 Metallurgical Examination of Fracture Samples by Ken Willens

The first piece of evidence that will be presented in "Investigation and Analysis" will be the memorandum from Ken Willens to John Hoffman. Ken Willens's memo provides the metallurgical examination of fracture samples removed from the discharge gate. In particular, Willens discusses the 1"stainless steel bolt failure, the dowel pin failure and the tongue cover hold-down screw failure.

According to Willens's conclusion on bolt failure, the bolts failed by fatigue. The companion two bolts, which hold this flange in place, lost the preload, via loss of the nuts. This placed a major part of the load, of this joint, on the head of the single bolt. A bending moment and high tensile load was applied to the single bolt, which lead to its premature failure. This was most likely a predominately high stress, low frequency fatigue failure.

In Willens's opinion, this failure was secondary in nature. It is most likely that the bolt/nut(s) did not have an adequate preload, which was a prime contributor to its ultimate failure. The lateral movement based on the loss of the tongue covers most likely contributed to the ultimate failure. The bolt looks to have started with fatigue, ran across most of the cross section relatively rapidly, then progressed slowly, with a lower stress, and culminated with a small shear lip.

Next, Willens discusses dowel pin failure. According to Willens, the dowel crack initiation was most likely due to stress corrosion (SCC), or possibly, hydrogen induced cracking. Then subsequently failed via a rapid load type mechanism. This material is not only hard, but is relatively brittle, so it would not stand up to an impact, or shear type loading. This hardness level would also increase the sensitivity to SCC or hydrogen type cracking mechanisms. According to Willens, this was not a good material selection for the application. The heat treatment should have been at a temper temperature that would have produced a tough structure, not just hard. Willens also suspected that an adequate temper treatment, with a solid cross section would have been more suitable for the application. If this material was tempered in the 500-1050° F range, its lack of toughness could be due to temper embrittlement.

Lastly, Willens discusses the failure of the tongue cover hold-down screws. According to Willens, a significant quantity of Philips head cap screws most likely failed due to excessive tightening for the limited cross section between the slot depression and the first thread root of the screw. (Refer to Figure 15 for drill used in tightening of screws) In his opinion, a majority of these screws failed via shearing off of the heads. (Refer to Figure 16 of screws with sheared off heads) This proceeded rapidly as the tongue covers, on the moving gate side, slid off the gate tongue. The brittle nature of some of the cracks could suggest a temper, or hydrogen embrittlement mechanism facilitating the screw failures. It is very likely that hydrogen generated by the mixing of the steels and copper-silicon tongue covers generated enough hydrogen to induce cracking at the root of the threads. The hydrogen is of greater concern with static loading than with dynamic loading. In his opinion, the material combination used here predisposed the screws to failure.

Figure 15: Drill Used to Fasten Screws on RHCo Gate

Figure 16: Damaged Screw from RHCo Gate

In conclusion, Willens ends with a general comment in his memorandum. According to Willens, in martensitic stainless steels, intergranular cracking is the rule when heat-treat procedures result in carbide precipitation to the grain boundaries. This could explain some of the intergranular cracking observed in some of the specimens.

These higher strength martensitic steels are subject to SCC and to a greater degree, hydrogen damage. It is difficult to tell the difference. The hydrogen damage has been known to be generated in a fresh water environment at room temperature.

The mix of materials: copper-silicon, cast iron, and martensitic stainless steel in a moist environment may have generated enough hydrogen, due to galvanic corrosion, to induce brittle fracture in some of the 400 series stainless steels.

6.5.2 Deposition and Analysis of Brian Richardson on Behalf of Duke Engineering & Services

Brian Richardson gave his deposition on behalf of Vermont Yankee as a consulting engineer. Richardson has a Bachelor's of Science Degree in Mechanical Engineering from the University of Massachusetts. He is also a Registered Professional Engineer in Maine, Illinois, Indiana, and Massachusetts. At the time of this case, he was the Manager of Engineering for Duke Engineering & Services in Portland, Maine. As the manager of engineering, he supervises a team of department heads and engineers in several disciplines: mechanical, electrical, civil, structural, and geotechnical. He also reviews their work and participates in their projects.

Richardson was contacted in October of 2000 by Robert Oliver (of Vermont Yankee) to act as an expert witness with regard to the arbitration involving a gate installation. In his deposition he discusses the design of the sluice gate and its intended application at Vermont Yankee.

In his deposition, Richardson agrees with Attorney McGee that to properly design bypass gates for the discharge structure, one should have knowledge of the flow from the cooling towers. He also notes that other factors must be taken into account when designing a bypass gate. One other factor would be to ensure that the gate meets the environmental licensing agreements through this plant with regard to the Connecticut River.

Later in the deposition, Attorney McGee suggests that Richardson does not have a fundamental understanding of the operation of the Vermont Yankee Nuclear Power Plant. McGee suggests this because Attorney Readnour corrects Richardson's testimony concerning the difference between the hybrid and closed cycles of the gates.

The questioning between Attorney McGee and Richardson continued. The next topic of conversation concerns throttling applications on bypass gates. According to Richardson, a throttling application for a sluice gate is when the gate is in an intermediate position acting as a weir, partially restricting the flow. Richardson agrees with McGee's statement that if you were trying to determine what would be the appropriate gate to use as a bypass gate, you would want to know whether the bypass gates were used in the throttling mode at the same time, as there is discharge from the cooling tower. In Richardson's expert opinion, the Rodney Hunt bypass gates used by Vermont Yankee were defectively designed and manufactured. However, he thought that they were probably installed correctly. Richardson did not reach this professional opinion until he reviewed the marked up drawings and other materials from discovery of Rodney Hunt. Richardson reviewed computations from the drawings with Adam Jones, Stephen Spain and Bob Oliver. Bob Oliver reviewed the computations regarding shear loads on the screws that attached the bronze covers to the tongues.

Next, there is discussion as to the definition of a general sluice gate application. Richardson defines this as being a low-duty, low head application. He also testifies that the Rodney Hunt gates used at Vermont Yankee would be adequate for general sluice gate applications. However, he does not mention at this time if the Vermont Yankee sluice gates were considered a general application.

Shortly after, Richardson is asked to list every way in which the Rodney Hunt gates were defectively designed. The list is as follows:

- Improper size of tongue (too small)
- The choice of bronze covers on the tongue and in the guide (Refer to Figure 17 for guide)
- The fact that the bronze covers were both on the tongue and in the guide
- The design of the attachment mechanism of the bronze covers to the tongue to the guide
- The use of either 304 or 410 stainless steel screws to fasten the tongue covers and guide liners
- The choice of spring pins in design instead of dowels

Figure 17: Bronze Covers on Tongue of Sluice Gate

Discussion of material selection was also presented. Particularly they discussed whether or not steel gate should be substituted for cast iron gate. According to Richardson, steel can have porosity and localized changes in properties, making cast iron a better selection in some applications.

Besides Richardson's deposition, it is also important to review his report that he produced for Duke Engineering & Services on June 28, 2001. The following list was taken directly from a report produced by Richardson. This list includes his general conclusion and opinions of what caused the gates to fail for Vermont Yankee.

1. The two RHCo gates failed because the 410 stainless steel Philips head screws used by RHCo to hold down the tongue covers on the gates were not adequate to accomplish the purpose. These screws were improperly used despite notes on RHCo design drawings and internal engineering instructions to utilize 304 stainless steel slotted machine screws because of negligent and improper manufacturing and quality control procedures.
2. Notwithstanding the fact that unspecified screws were used in assembly of the gates, the intended covers, as called out on their drawings were a poor design choice. Their use would also have been inadequate to accomplish secure attachment of the bronze wear strips to the gate. The like-new design proposed by Cianbro and RHCo using the same attachment method was an adequate design and thus would have been an inadequate repair.

3. The use of the small gate tongue in combination with the flawed tongue cover attachment design was not a robust design and was vulnerable to catastrophic failure. The cast iron tongue dimension is 5/8-inch by 7/8 covered by a 1/8-inch bronze wear strip. A tongue significantly less than 1-inch in cross-section is very small in comparison to a 10-foot by 13-foot gate, has an adequate safety factor, yet it requires unnecessarily close tolerances and has little forgiveness.
4. The RHCo organization utilized poor design and engineering practices and procedures leading to mistakes and to gate failure. There appears to have been no design of or computations for the fastener system that failed. The overall gate design appears to have ignored customer operation data, and experience and site conditions. This approach violates general quality control principles and was a direct contributor to the gate failure.
5. The RHCo design did not meet the safety factor requirements of Ebasco specification, representations found in its own sales literature, or standard industry design practices. Both Cianbro and RHCo had available all information necessary to allow them to provide a suitable design and meet the requirements of the contracts.
6. As prime contractor, Cianbro was responsible for proper installation of the gates and for determining that the mounting surface of the gates was adequate. If the wall thimbles are distorted as Cianbro and RHCo allege, Cianbro did not follow usual and customary practices in establishing, and adjusting or repairing if necessary, important existing conditions prior to installing the gates.
7. Cianbro executed a turnkey contract with VY. It was incumbent upon Cianbro to communicate customer expectations to their subcontractor, RHCo. There was an apparent failure to communicate VY's expectations and requirements. It was their responsibility to assure a satisfactory gate was provided.
8. Given Cianbro's responsibilities for proper installation, it had a duty to seek adequate instruction from RHCo at critical points in the installation of the gates. The manufacturer has experience and detailed knowledge of important methods, means, critical dimensions, and characteristics related to installation of their manufactured product. Cianbro had a duty to obtain critical information and to

utilize it at critical points in the installation of the gates. For example, if wall thimble alignment was critical, Cianbro was responsible for obtaining the information and taking appropriate actions.

9. VY understands that RHCo has stated that if the wall thimbles were distorted, the gates will not work properly and that they also claim that the distortion of the VY thimbles were a factor in the gate failure. Therefore, the Cianbro/RHCo proposed like new repair of the gates would not have satisfactorily operated.
10. Cianbro and RHCo allege that turbulence was a significant factor in the failure of the gates. If it was an important factor, Cianbro and RHCo should have considered and included existing and obvious site operating characteristics such as turbulent flow into the design of the gates. Neither RHCo nor Cianbro explicitly factored existing environmental factors into the design and would thus be responsible for the gate failure caused by turbulence-induced vibration.

6.5.3 Deposition and Analysis of Robert Oliver on Behalf of Vermont Yankee

The next noteworthy deposition is that of Robert Oliver, a civil/structural engineer employed by Vermont Yankee Nuclear Power Corporation. Mr. Oliver gave a deposition concerning the bypass control gates at Vermont Yankee. His deposition began with his definition of "design", in reference to the bypass control gates. The reason being that this deposition was based upon improper design and improper manufacture and installation on behalf of the contractor (Cianbro) and subcontractor (Rodney Hunt). Next, he compared the differences between the original ARMCO gates and the new Whipps gates. He mentioned that the new Whipps gates had a full finite element analysis.

In his deposition, Oliver also discusses how the liners on the south gate came off. It is important to note that Oliver formed this conclusion after discussing the installation procedures of the tongue liners with Paul Stucchi, a technician for repair at RHCo. Oliver claims that Stucchi said that it was possible that the attaching screws for the tongue liners were sheared off, as a result of using an impact gun. Also, for the first time in the case, the term "wedge design" is used to describe the gates in question. He also mentions that after a visit to Rodney Hunt, he wrote a trip report that included calculations showing that on a static head the tongue is not highly loaded. These conclusions also led Oliver to believe that the stresses were low and that the gate was designed to meet these levels of stress.

Next, Oliver mentions the purpose of doweling, based upon his discussion with the American Waterworks Association (AWA). The dowels are used to hold everything together (and in line) in the gate in case of failure. Oliver also mentioned the Ebasco Specifications of the Vermont Yankee gates. He said that the specifications called for "large margins of safety in the design of these gates." He also stated that he Ebasco Specs provided the design head, flow conditions, the head of water and opening sizes. However, velocity is not given. It is important to note that Oliver stated that he did not know the root cause or the effective failure mechanism of the gates. However, he said that the gates were not of robust design.

The last piece of noteworthy evidence that Oliver provides is his Statement of Facts, given in his memo to James Callaghan on January 10, 2000 is as follows:

- The original discharge gates were a wedge type design, were used with an unseating head, and lasted 26 years of operation with a minimum usage of 100 strokes per year.
- The replacement gates operated for 44 strokes before discovery of degraded condition.
- The bronze tongue liners fell or were ejected from both the North and South gate/guide assemblies during gate operation.
- The South gate was jammed and the south side guides had been displaced, allowing the gate to come out of its tracks.
- The South gate had loose bolts, missing bolts, sheared bolts, and missing and damaged wedges.
- The North gate had loose bolts, missing bolts, and loose wedges.
- The "Philips" head screws were a self-tapping type, and had no shank between the underside of the countersink and the threads.
- The "Philips" head screws had the slots for the screwdriver projecting into the thread area of the screw.
- The "Philips" head screw material did not meet the vendor drawing requirements.
- The "Philips" head screws used to attach the tongue liners to the gates all failed.

- The replacement gates had no detailed design for gate tongue liners and fasteners.
- The purchase specification requirement for dowels to prevent relative motion between the guides and frame was not met.
- Excessive play between the gates and the guides resulted when the bronze tongue liners were not in place.
- Coefficient of friction for bronze on bronze is four times larger than that for bronze on cast iron.
- No locking devices such as cotter pins, "nylock" nuts or tack welding, were used on the gate and guide assembly studs/bolts/mounting bolts to prevent the nuts from loosening during operations. The wedges on the gates were double nutted.

6.5.4 Review of Sluice Gate Failure at Vermont Yankee by Paul J. Williams of Kleinschmidt Associates

To begin, Paul J. Williams's understanding of the problem, sequence of events and the technical details of the circulating cooling water system and bypass gates are based upon review of specifications. He also reviewed purchase orders, correspondence reports, drawings and depositions, as well as visited the Vermont Yankee site on June 6, 2001 to observe the facilities. Williams also observed the current replacement gates and the components comprising the Rodney Hunt gates, which were removed from service and were stored on Vermont Yankee property.

According to Williams, at the time Vermont Yankee requested a proposal for a replacement gate for the ARMCO gate, there were existing conditions that factored in to the type of gate requested. The most significant was the physical works in place. Any replacement, for practical and economic considerations, had to conform to the existing conditions both physical and operational. The physical conditions included the location of the gate on the east side of the discharge structure wall, mounted in an inverted position and subject to an unseating head. More specifically, the replacement gate had to utilize the existing wall thimble. The replacement gate also had to use the existing hydraulic operators and operation system.

The operational conditions included the gate's proximity to the cooling tower discharge even though this location was suspected of inducing vibration to the gates. Vermont Yankee maintenance records for the ARMCO gate indicated that there were a number of instances where broken, loose and missing wedges and attachment bolts were discovered, and the tongue and guides were excessively worn eventually causing the disc to come out of the guide. The cause of these problems had been noted to be vibration due to the modulating mode of operation of the gates and corresponding discharge frame of the cooling towers. It is apparent that Vermont Yankee anticipated continuing vibration related maintenance problems as they specifically requested a wear element that was easily replaceable, i.e. the bronze tongue covers and guide liners. No effort or modification was made to deal with the effects of the vibration. Vermont Yankee's decision to use the Ebasco specification from 1969 implies that the performance of this type of gate had been found to be acceptable.

A number of possible modifications could have been made to the cooling tower discharge location to mitigate effects on the bypass gates. These may have included hoods, deflectors or baffles to redirect the discharge to the river. Williams claims that he was not aware of any investigations into modifications to mitigate the source of vibration. Vermont Yankee also accepted a replacement gate that had less weight than the ARMCO gate.

From Williams's experience with the design of water control gates, a seating head is generally preferred over an unseating head. The gate is typically less expensive and easier to build and seal. Downward opening is sometimes desired usually when sluicing floating debris. A gate intended for flow regulation could be either upward or downward opening. When downward opening is adopted, it is preferable to keep the operator stem out of the flow path for a number of reasons. The stem is subject to impact damage from floating debris, which has a tendency to collect debris. This reduces the gate discharge and can also cause vibration.

The above being said, the use of cast iron sluice gates under unseating head conditions is accepted practice in the water control industry. Certain design features are employed to maintain water tightness and reduce stresses. These features include the use of wedges and reinforcing ribs, which are well documented in Rodney Hunt gate literature and were used on the Vermont Yankee application. The fact that the original gates were in service form 1969 to 1998 indicates that this type of gate design can provide satisfactory service. A change in the operation of the cooling water system resulted in additional vibration and stresses being placed on the gate. Vermont Yankee documented a number of instances where broken, loose or missing wedges and bolts, and broken stem guides were discovered and attributed the case to vibration. Vermont Yankee event Report #96-0842 states in part "each year the Bypass Gates require repair or re-adjustment of the wedge blocks. The cause of this is that the Circ Water flow (over the gate, with the gate fully open) forces water both over the gate and some water to pass between the gate and the discharge structure wall. This situation causes some vibration of the gate to occur, especially on the upper end of the gate and has been the cause of the loosening and damage to the upper wedge blocks in the past." The only modification that the writer is aware of to deal with vibration was Vermont Yankee's request to add bronze tongue and guide liners. Rodney Hunt has used this feature successfully on many prior applications. To complement the replaceable tongue covers, the gate guide and frame were supplied as separate pieces so the guides could be easily removed to replace the bronze liners.

Rodney Hunt proposed a tongue cover detail that had proven successful in previous applications. The bronze covers were 0.25 inches thick and were detailed so that a 1/16-inch clearance was provided on all sides of the tongue. Quarter-20 stainless steel screws were proposed at 6 inch spacing for a total of 27 screws per tongue or 54 per gate.

The Ebasco spec called for Type 416 stainless steel to be used for stems and fasteners. Rodney Hunt proposed Type 304 stainless steel for the tongue cover screws, which was approved by Vermont Yankee. During fabrication, Type 410 stainless steel screws were utilized. 410 stainless steel screws have the same mechanical properties as 416 stainless steel screws. 416 stainless are a free-machining version of 410, where sulphur is usually added to the chemical composition to improve high-speed machinability. (Refer to the table below for the mechanical properties of 410 and 304 martensitic stainless steel screws according to the Materials in Design Engineering book.)

Stainless steels	**410**	**304**
Tension strength, 1000psi		
Annealed	65-75	84,82,85
Hardened & Temp.	90-190	110
Yield strength, 1000psi		
Annealed	35-45	42,35,35
Hardened & Temp.	60-145	75
Elongation %(in 2 in)		
Annealed	25-35	55,60,60
Cold worked	15-30	60

In the deposition of Robert Oliver of Vermont Yankee, Mr. Oliver stated that he assumed a coefficient of friction between bronze on bronze as 0.88 and the coefficient of friction between bronze and cast iron as 0.22. He references Mark's Handbook, which does not list a value for bronze on bronze. The Tool Engineers Handbook, 2nd Ed., 1959, published by the American Society of Tool and Manufacturing Engineers shows on pp. 101-112 a coefficient between bronze and bronze of 0.20 and a coefficient of bronze on cast iron as 0.21. The coefficient for bronze on cast iron agrees with the reference from Mark's Handbook. According to the Tool Engineers Handbook, the coefficient of friction between bronze and bronze is actually slightly less than that between bronze and cast iron. It should be noted that these values are in the dry condition. Values for a wet condition would be expected to be less than the dry values. (Refer to Figure 18 for the calculations of the coefficient of dry friction between the RHCo bronze sliders)

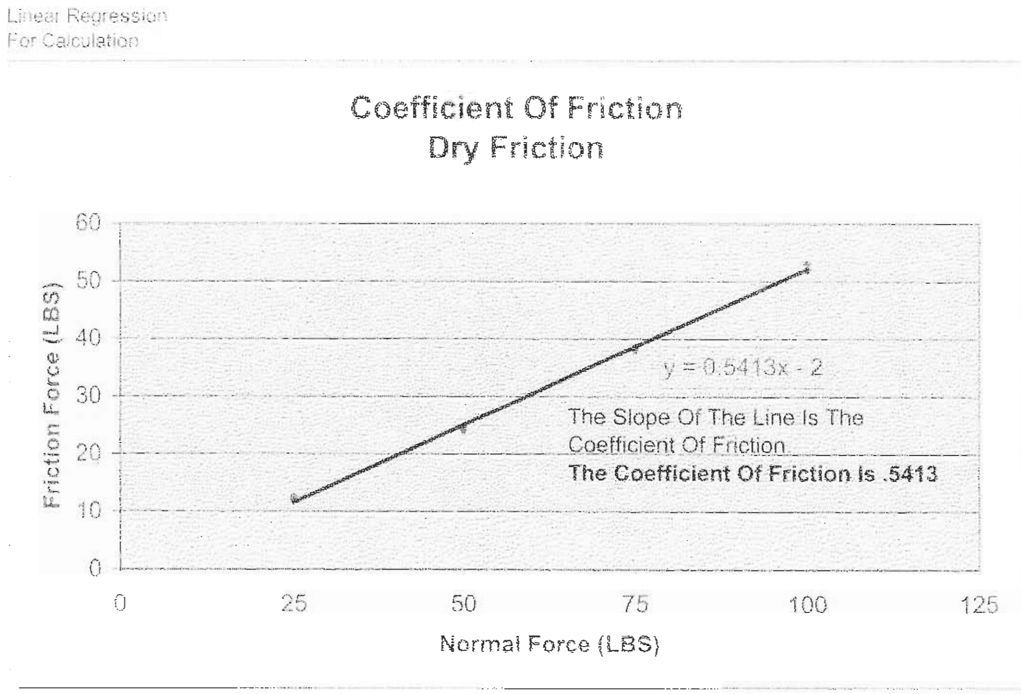

Figure 18: Coefficient of Friction Between RHCo Bronze Sliders

Mr. Oliver's estimation of friction force is based upon the actual load that the gate head times the appropriate coefficient of friction between the bearing surfaces at the time the gate moves or attempts to move. The load is based upon the differential head across the gate, i.e., the difference between the water level on the upstream side of the gate and the water level on the downstream side and also upon the area of the gate exposed to the differential head. For a constant differential head, the gate sees the maximum friction force when it is in the closed position. At this point, the maximum area is exposed to the differential head. As the gate opens in a downward direction, less of the gate area is exposed to the differential head.

It is important to note that in the closed position, the bearing surfaces are the faces of the wedges. Once the wedge faces disengage, the bearing surfaces should be the tongue surfaces. Mr. Oliver's calculations should be based upon the position of the gate when the wedge surfaces are no longer touching, the prevailing head levels upstream and downstream, and the area of the gate exposed to the differential head and the coefficient of friction between bronze on bronze (which he has over estimated by more than a factor of four). Any conclusions drawn from his calculations about the shearing forces on the screws would be based upon overestimated friction forces.

The screws used to attach the tongue covers were a self-tapping Phillips head stainless steel screw made of Type 410 stainless. There are two basic types of self-tapping screws, thread forming and thread cutting. Their function and use is similar although they require different size pre-drilled holes. Records indicate that the screws used were a type F, which is a thread cutting screw. Machinery's Handbook indicates a Type F self-tap screw is appropriate for cast iron. According to machinery's Handbook p. 1252 the required hole size is 0.2344. Rodney Hunt testified that the holes were pre-drilled to 15/64 or 0.23438, which is the proper hole size for this screw.

Williams believes that vibration caused the attachment screws to loosen and back out of position. Once this happens, the sharp edge of the counter-sunk screw head catches on the fixed guide liner causing a significant increase in resistance and exerting a bending and shear force on the screw. Williams also observed a number of screws in the old tongues that were bent in different directions. This would disprove the over torqued at installation theory as the screws had to have enough structural integrity to bend before failing. As the screws back out and bend, they impart a prying action on the tongue cover, which adds to the shearing forces that are already there due to friction. The more screws that back out and bend, the higher the applied prying forces will be. As screws fail, there is less resistance to the forces and ultimately the remaining screws cannot take the shear forces and they fail, causing the tongue covers to drop out. Many tongue covers were intact. They showed evidence of "rat-tailed" or elongated holes indicating that the gate had moved in both directions. Williams also noted orbital scars on the guide liners suggesting that the gates were vibrating with the screw heads etching the displacement of the gate. He also believed that the screws failed from a combination of shear and bending and that fatigue had reduced the ultimate strength of the fasteners.

Standard shop production practice is to install screws with a torque-limiting tool. (Refer to Figure 19) The screw geometry and material selection was appropriate for this application. It is unknown what the actual torque was that was applied during the assembly process.

Figure 19: Torque-Limiting Drill

Given the geometry of the gate, it is likely that the tongue cover attachment screws were installed while the gate was in a horizontal plane. Mr. Willens's opinion is that the majority of screws failed during the assembly process due to "over-torquing", and were held in place by "smeared metal and oxides". It is virtually impossible that the majority of 108 fasteners could have failed during installation on the shop floor without being noticed by the installer. Since these fasteners were being installed horizontally, if the head sheared off it would fall to the floor when the drive tool was removed. This obviously would have caught the attention of the installer.

It is also common to see marks from the drive tool as the screw reaches its torque value and the drive tool is removed, as the tool is usually still spinning. The presence of these marks does not necessarily indicate over tightening. Mr. Willens refers to the presence of oxides in the fractured screws as evidence of "old" breaks. It is Williams's understanding that sulphuric acid is added to the cooling water to retard decay in the wooden cooling tower structures. Mr. Willens's report does not address what role if any the acid had on oxidation of broken fasteners.

The following list is conclusions from Williams in reference to the sluice gate failure at Vermont Yankee:

1. The basic application of this style sluice gate was appropriate.

2. Rodney Hunt and Cianbro conformed to Vermont Yankee's specifications.
3. Vermont Yankee did not fully convey the gate operating conditions to Rodney Hunt and Cianbro.
4. Vermont Yankee's procurement specification was very specific and precluded alternate design proposals.
5. Details of the Rodney Hunt gate were based upon good engineering practice and successful past experience.
6. The mode of operation exacerbated gate vibration problems.
7. Vibration caused the tongue cover attachment screws to fail resulting in the loss of the tongue covers.
8. The loss of the tongue covers created excessive clearances, which led to the south gate leaving the guide.
9. Early notification of gate operating problems to Cianbro and Rodney Hunt would have greatly minimized gate damage.
10. Cianbro's June 30, 1999 repair plan was workable and would have resulted in restoring the gate to "like new" condition.

6.5.5 Deposition of Paul Gallo

Paul Gallo is the Vice President of Engineering and Manufacturing for Rodney Hunt Corporation. Gallo's deposition is important because it discusses the Circulating Water System Hydraulic Gradient at Vermont Yankee. According to Gallo, the hydraulic gradient shows a TDH (total dynamic head) of 72.4 ft at the Discharge Structure on the Outlet Line from the Cooling Tower. This is in contrast to the Max Head values of 32 ft Seating and 23 ft Unseating, listed in the specifications for the gate design. (See Table below for Ebasco Specifications for Intake and Discharge Control Gates) Gallo also states that there is nothing elsewhere in the specifications or Vermont Yankee drawings that communicates the existence of a 72.4 ft head flowing against the gates.

Location of Gates	Required Number	Size (ft)	Max Head Seating (ft)	Max Head Unseating (ft)
Intake Entrance	3	12'x22'	39'	39'
Discharge Channels	2	11'x13'	32'	23'
Discharge Exit	1	11'x11'	23'	23'

In Gallo's opinion, the technical information contained in the hydraulic gradient drawing is significant with respect to the gate design. This dynamic condition causes impact loads and vibration detrimental to the gates, since the gates were not designed for these conditions.

It is quite plausible that the impact/vibration loads associated with the cooling tower flows exacerbated the stresses of operating through the bind, caused by the wall thimble distortion. The gates were not designed for either the binding loads or the cooling tower impact loads, since there was no information indicating the existence of the underlying conditions, which produce these loads, nor these "normal" binding conditions Rodney Hunt would design for anyways.

Gallo also restates in his deposition that the gates operated with hydraulic cylinders. At the discharge gate, these cylinders output 109,703 psi when opening, and 136,708 psi when closing. The screws used on the discharge gate were rated to withstand over 3,000 psi. There was a total 54 screws holding the tongue covers to the tongues on the discharge. This would be equal to 162,000 psi exerted on the 54 screws. However, when the gate would bind, the pressure exerted on each screw was not equal. The area of the bind would have more pressure exerted on those screws. Therefore, the screws closer to the bind failed and broke first. After those screws broke (near the bind) others would break because more pressure would be exerted on them as well.

As stated earlier, the max cylinder output on the screws was 136,708 psi. If this number were divided by 54, (the number of screws holding the tongue covers to the tongue) each screw would have approximately 2,532 psi on it. This number is still 468 psi less than each screw's maximum allowable load of 3,000 psi.

6.6 Final Assessment

One of the most crucial issues involved in this case is engineering design. We, as engineers, when developing new products, should design our products based upon the best technology and materials available at the time. However, in the case of Vermont Yankee Nuclear Power Corporation v. the Cianbro Corporation v. Rodney Hunt Company, Cianbro was not developing a new sluice gate application, rather, they were modifying an existing structure, in accordance to the Vermont Yankee specification and the Ebasco specifications of 1969. In Vermont Yankee's defense, the existing ARMCO gate lasted 26 years with minimal maintenance. For that reason, it is easy to understand why they would want an exact replacement. However, Vermont Yankee did not take into account that the physical environment in which the sluice gates were situated changed over an extended period of time. In fact, the gates' existing wall thimbles were no longer flat after 26 years. Also, the problem of excessive turbulent flow induced vibration was never addressed in the contract between Vermont Yankee and Cianbro. Vermont Yankee maintenance records for the ARMCO gates indicate that there were a number of instances where broken, loose and missing wedges and attachment bolts were discovered, and the tongue and guides were excessively worn eventually causing the disc to come out of the guide. The cause of these problems had been noted to be vibration due to the modulating mode of operation of the gates and the corresponding discharge from the cooling towers. It is apparent that Vermont Yankee anticipated continuing vibration related maintenance problems as they specifically requested a wear element that was easily replaceable, i.e., the bronze tongue covers and guide liners. No effort or modification was made to deal with the effects of the vibration. Vermont Yankee's decision to use the Ebasco specification from 1969 implies that the performance of this type of gate had been found to be acceptable. However, there were no attempts made in any of the contract documents to make the contractor aware of this pre-existing condition.

In accordance with the contract documents, the replacement gates were required to be installed on the existing ARMCO wall thimbles. The replacement gates were installed in strict accordance with installation procedures that were either generated by or approved by Vermont Yankee. There were no provisions in the installation procedures to check for wall thimble distortion.

The second factor of Cianbro's denial for the warranty claim was Vermont Yankee's improper operational practices. These improper operational practices contributed to the gate failure and exacerbated the damage once the failure was initiated. These improper operation practices are as follows:

- Operating procedures were changed to compensate for an abnormal condition rather than to investigate and resolve the condition. The procedure changes were apparently not supported by any technical evaluation.
- The system was operated for an undetermined period of time in manual with all system protective devices disabled. No evidence could be found to indicate that any interim actions were taken to compensate for the loss of the protective devices and "Temporary Modification" controls apparently were not put in place.
- The gates were not monitored during operation in spite of the fact that the procedures were newly revised and there were known problems with the operation.
- Although the gates were brand new and had experienced operational anomalies, operating records were not kept or maintained that were of sufficient quality as to be able to reconstruct the events leading to the failure.
- The system was operated in a mode that had been identified previously, in Vermont Yankee Event Report #96-0842, as not having received proper evaluation and being the most likely cause of excessive vibration that led to subsequent failure.
- The official gate report, "Evaluation of Discharge Gate Failure", VYM 99/158, was not received by the PORC or by any individual normally responsible for performing root cause evaluations.

The third factor of Cianbro's deny for the warranty claim was Vermont Yankee's failure to communicate operational problems in a timely fashion.

- When Vermont Yankee became aware of operational problems with the newly installed gates, on May 31, 1998, they neglected to notify the Contractor or the gate Vendor. A period of 10 months elapsed before the gate Vendor or Cianbro became aware that operational problems had been encountered. All the while, the gates were sustaining additional damage.

- When subsequent failure of the PCL power supply caused the HPU to become inoperable, Vermont Yankee again neglected to notify either the Contractor or the gate Vendor. While the HPU was inoperable, the gates had to be operated locally, with no system protective devices active, thereby potentially subjecting them to additional harm.

By electing not to notify the contractor of operational problems when they were first encountered, Vermont Yankee eliminated any opportunity the contractor had of affecting a timely repair before serious damage could occur. They further prevented the contractor from having the opportunity to take compensatory actions that would have mitigated the extent of the damage.

If Vermont Yankee had contacted Cianbro about their operation problems in a timely manner (earlier), adjustment or modifications could have been made to repair the gates. There is also the possibility that Cianbro would have looked into the issue as to why the gates were not operating properly. Since Cianbro was not given this opportunity, they should not be liable for the damages incurred by improper operation of the gates by Vermont Yankee. Lastly, in Rodney Hunt's defense, this company was never given any information concerning the hydraulic gradient, TDH (total dynamic head) or the cross flows against the side of the discharge gates.