SUMMARY OF SAFETY AND EFFECTIVENESS DATA

I. GENERAL INFORMATION

Device Generic Name: Intravascular Stent with Delivery System

Device Trade Name: Liberté™ Monorail™ Coronary Stent System
Liberté™ Over The Wire Coronary Stent System

Applicant's Name and Address: Boston Scientific
One Scimed Place
Maple Grove, MN 55311

Premarket Approval Application (PMA) Number: P040016

Date of Panel Recommendation: None

Date of Notice of Approval To Applicant: April 12, 2005

II. INDICATIONS FOR USE

The Liberté™ Over-The-Wire and Monorail® Coronary Stent Systems are indicated for improving coronary luminal diameter in the following:

• Patients with symptomatic ischemic disease associated with stenotic lesions in native coronary arteries (length ≤ 28 mm) with a reference vessel diameter of 2.75 to 5.0 mm.

III. CONTRAINDICATIONS

The Liberté™ stent is contraindicated for use in:

- patients in whom antiplatelet and/or anticoagulant therapy is contraindicated
- patients who are judged to have a lesion that prevents complete inflation of an angioplasty balloon
- patients with known allergies to stainless steel.

IV. WARNINGS AND PRECAUTIONS

Please refer to the device labeling for a list of warnings and precautions.

V. Device Description

The Boston Scientific Liberté™ Coronary Stent System (CSS) consists of a balloon expandable stent, pre-mounted on a high-pressure delivery catheter used in the treatment of coronary artery disease. Two delivery catheters represent The Liberté™ Coronary

Stent Systems: Liberté™ Monorail™ (MR) and Liberté™ Over the Wire (OTW) Stent Delivery Systems (SDS). **Table 1** contains characteristics of the Stent Delivery Systems.

Table 1. Stent Delivery System Specifications

Stent Diameter	Nominal Pressure	Rated Burst Pressure	Liberté™ MR Guide Compatibility	Liberté™ OTW Guide Compatibility
2.75 mm	9 Atm	18 Atm	5 F (.058")	6F (.066")
3.00 mm	9 Atm	18 Atm	5 F (.058")	6F (.066")
3.50 mm	9 Atm	18 Atm	5 F (.058")	6F (.066")
4.00 mm	9 Atm	18 Atm	5 F (.058")	6F (.066")
4.50 mm	9 Atm	16 Atm	6F (.066")	6F (.066")
5.00 mm	9 Atm	16 Atm	6F (.066")	6F (.066")

The Liberté™ MR and OTW Stent Delivery Systems are each available in 40 device models with stent diameters of 2.75, 3.0, 3.5, 4.0, 4.5 and 5.0 mm and stent lengths of 8, 12, 16, 20, 24, 28, and 32 mm, as shown in **Table 2**.

Table 2. Liberté™ MR and OTW System Product Matrix

		Stent Length						
		8 mm	**12 mm**	**16 mm**	**20 mm**	**24 mm**	**28mm**	**32 mm**
Stent Diameters	**2.75 mm**	X	X	X	X	X	X	X
	3.00 mm	X	X	X	X	X	X	X
	3.50 mm	X	X	X	X	X	X	X
		Designated Stent Model Separation						
	4.00 mm	X	X	X	X	X	X	X
	4.50 mm		X	X	X	X	X	X
	5.00 mm		X	X	X	X	X	X

The Liberté™ MR Stent delivery system centers the stent on a high pressure Dynaleap™ balloon between two radiopaque marker bands. The distal section of the MR catheter is dual, coaxial lumens. The outer lumen is used for inflation and deflation of the balloon, which results in deployment and expansion of the stent. The inner lumen permits the use of guide wires (< 0.014 inches) to facilitate advancement of the catheter through the stenosis to be stented. The proximal section of the catheter is a single lumen, PTFE coated, stainless steel hypotube with a single luer port for inflation and deflation of the balloon. The distal shaft (excluding the stent region) of the delivery system is coated with a hydrophilic coating. A soft outer component lumen is bonded over and extends beyond the inner. The catheter includes a tapered tip.

The Liberté™ OTW Stent delivery system centers the stent on a high pressure Dynaleap™ balloon between two radiopaque marker bands. The balloon extends approximately 0.3 mm beyond the stent ends. The Liberté™ OTW delivery system has an outer shaft that is composed of a proximal and distal segment bonded at the midshaft location. A stainless steel spiral cut hypotube is located under the junction between the proximal and distal shaft segments. The inner shaft, which provides a pathway for the guide wire, is tapered at the midshaft and distal end. It extends to the end of the balloon.

The distal shaft of the delivery system is coated with a hydrophilic coating to enhance device performance.

The same Liberté™ stent is used on both the Liberté™ MR CSS and the Liberté™ OTW CSS. The Liberté™ Stent is laser cut from a 316L stainless steel tube into a specific geometric pattern. The pattern consists of a multitude of radially expandable elements with varying amplitude. The stent design consists of a dimensionally uniform pattern of radially expandable elements that share junctions with adjacent radially expandable elements.

VI. ALTERNATIVE PRACTICE AND PROCEDURES

Alternative treatments of coronary atherosclerotic disease include diet, medication (e.g. thrombolysis), atherectomy, balloon angioplasty, coronary bypass (CABG) surgery or stenting with commercially available stents.

VII. MARKETING HISTORY

The Liberté™ Coronary Stent Systems are commercially available in the countries listed in **Table 3.**

Table 3. Countries Where Liberté™ is Commercially Available

Argentina	Egypt	Korea	Singapore
Austria	Finland	Liechtenstein	South Africa
Australia	France	Luxemburg	Spain
Belgium	Germany	Malaysia	Sweden
Brazil	Greece	Mexico	Switzerland
Brunei	Hong Kong	Morocco	Taiwan
Bulgaria	Hungary	Netherlands	Thailand
Canada	Iceland	Norway	Turkey
Chile	India	New Zealand	United Kingdom
China	Ireland	Peru	Uruguay
Columbia	Israel	Philippines	Vietnam
Czech Rep.	Italy	Poland	
Denmark	Jordan	Portugal	

No Liberté™ products have been withdrawn from the market in any country for any reason.

VIII. SUMMARY OF NON-CLINICAL STUDIES

A. Biocompatibility

1. Liberté™ Monorail™ CSS

Table 4 lists tests conducted to demonstrate that the components of the Liberté™ MR Coronary Stent System are non-toxic. Testing was conducted in accordance with the FDA Guidance for the Submission of Research and Marketing Applications for Interventional Cardiology Devices, May 1995 and in accordance with the International Standard EN/ISO-10993-1, "Biological Evaluation of

Medical Devices Part 1-: Evaluation and Testing." The Liberté™ MR CSS is a combination of the same materials in the same relative proportions, manufactured in the same location and using essentially the same manufacturing methods used for the established Express2™ Monorail™ Coronary Stent System (P020009) or Maverick® Monorail™ PTCA catheter (P860019/S160), and the Quantum™ Maverick® PTCA catheter (P860019/S182). Testing was done on the finished, sterilized Express2™Monorail, Express® Monorail, or Maverick® Monorail™ PTCA catheters, except where noted.

Table 4.Liberté™ MR CSS Biocompatibility Test Results

Test Performed	Test Device Type	Results
ISO 10993-3 Ames Mutagenicity	Liberté™ Bare Stents	**Non-mutagenic**
USP Physicochemical Test for Plastics	Liberté™ SDS (stent & catheter)	**Pass**
ISO 10993-4 Direct Hemolysis	Liberté™ SDS (stent & catheter) Express2	**Non-hemolytic**
ISO 10993-5 Cytotoxicity MEM Elution	Liberté™ SDS (stent & catheter)	**Non-cytotoxic**
ISO 10993-5 Cytotoxicity MEM Elution	Maverick® Monorail™ Catheter Express® Monorail™ Delivery System + stent	**Non-cytotoxic**
ISO 10993-10 Skin Sensitization Kligman	Maverick® Monorail™ Catheter Express® Monorail™ Delivery System + stent	**Non-skin sensitizing**
ISO 10993-10 Intracutaneous Injection	Maverick® Monorail™ Catheter Express® Monorail™ Delivery System + stent	**Met USP Injection Test**
ISO 10993-11Systemic Toxicity	Maverick® Monorail™ Catheter Express® Monorail™ Delivery System + stent	**Not a systemic toxin**
ISO 10993-11, Material Mediated Rabbit Pyrogenicity	Express2™Monorail™Delivery System	**Non-pyrogenic**
Pyrogenicity LAL	Express2™Monorail™Delivery Sys + stent	**Non-pyrogenic**
ISO 10993-11, Subchronic Toxicity	Express® Bare Stent	**No subchronic toxicity**
ISO 10993-4, Hemolysis	Maverick® Monorail™ Catheter Express® Monorail™ Delivery System + stent	**Non-hemolytic**
ISO 10993-4, *In Vitro* Hemocompatibility Assay	Express2™Monorail™Del System	**Pass**
ISO 10993-4, Thrombogenicity, Lee and White Coagulation	Express2™Monorail™Delivery System	**Pass**
USP Physicochemical Test for Plastics	Maverick® Monorail™ Catheter	**Pass**
ISO 10993-6, Intramuscular Implant-14 days	Express® bare stent	**Non-toxic**
ISO 10993-6,	Express® bare stent	**Non-toxic**

Intramuscular Implant-30 Days		

Genotoxicity, Chronic Toxicity, Carcinogenicity and Immunotoxicity testing were not carried out. These tests are traditionally only carried out on implanted materials. Because of the vast experience of using 316L stainless steel as an implant material, specifically for stents, this testing was not deemed necessary.

2. Liberté™ OTW CSS

Table 5 lists tests conducted to demonstrate that the components of the Liberté™ OTW Coronary Stent System are non-toxic. Testing was conducted in accordance with the FDA Guidance for the Submission of Research and Marketing Applications for Interventional Cardiology Devices, May 1995 and in accordance with the International Standard EN/ISO-10993, "Biological Evaluation of Medical Devices Part 1-: Evaluation and Testing." Most of the Liberté™ biocompatibility test results were originally provided in P020009 for the Express®/Express^{2}™ system (a few were done with the Liberté™). All materials used in the Liberté™ Over-the-Wire CSS have been previously used on the Express2™Over-the-Wire CSS (P020009), Maverick® Over-the-Wire PTCA catheter (P860019/S160), or the Quantum™ Maverick® PTCA catheter (P860019/S182). Testing was done on the finished, sterilized Express2™OTW, Express® Monorail, or Maverick® OTW PTCA catheters, except where noted.

Table 5. Liberté™ OTW CSS Biocompatibility Test Results

Test Performed	Test Device Type	Results
ISO 10993-5, Cytotoxicity MEM Elution	Maverick® OTW Catheter	**Non-cytotoxic**
ISO 10993-10, Skin Sensitization Kligman	Express® MR Delivery System + stent	**Non-skin sensitizing**
ISO 10993-5, Intracutaneous Injection	Maverick® OTW Cath	**Met USP Injection Test**
ISO 10993-11, Systemic Toxicity	Express® MR Delivery System + stent	**Not a systemic toxin**
ISO 10993-11, Material Mediated Rabbit Pyrogenicity	Maverick® OTW Catheter	**Non-pyrogenic**
Pyrogenicity LAL	Express® MR Delivery System + stent	**Non-pyrogenic**
ISO 10993-11, Subchronic Toxicity	Maverick® OTW Catheter	**No subchronic toxicity**
ISO 10993-4, Hemolysis	Express® MR Delivery System + stent	**Non-hemolytic**
ISO 10993-4, *In Vitro* Hemocompatibility Assay	Express^{2}™ OTW Delivery System	**Pass**
ISO 10993-4, Thrombogenicity, Lee and White Coagulation	Express^{2}™ OTW Delivery System + stent	**Pass**
USP Physicochemical Test for Plastics	Express® Bare Stent	**Pass**
ISO 10993-6, Intramuscular Implant-14 days	Maverick® OTW Catheter	**Non-toxic**
ISO 10993-6, Intramuscular Implant-30 Days	Express® MR Delivery System + stent	**Non-toxic**

Genotoxicity, Chronic Toxicity, Carcinogenicity and Immunotoxicity testing were not carried out. These tests are traditionally only carried out on implanted materials. Because of the vast experience of using 316L stainless steel as an implant material, specifically for stents, this testing was not deemed necessary.

B. Physical Testing

In vitro bench testing to support the Liberté™ MR and OTW Coronary Stent System was conducted, as applicable, in accordance with the FDA Guidance for the Submission of Research and Marketing Applications for Interventional Cardiology Devices, May 1995.

Part 1 Liberté™ Stent

The following is the *in vitro* testing to support the Liberté™ Stent as used in the Liberté™ CSS. Testing represents both the workhorse and large vessel stents in diameters of 2.75 to 3.5 mm and 4.0 to 5.0 mm, respectively. Stent length and diameter are not a factor in material specification conformance testing.

1) **Stent Material Specification Conformance Testing**

   a) **Material Analysis**

   The Liberté™ stent raw material was chemically analyzed and found to conform in both chemical analysis and the inclusion/impurity content as provided in ASTM-F 138, "Standard Specification for Wrought 18 Chromium-14 Nickel-2.5 Molybdenum Stainless Steel Bar and Wire for Surgical Implants (UNS S31673)".

   b) **Surface Contamination**

   The Liberté™ stent was examined by scanning electron microscopy (SEM) at 200X and 400X to detect evidence of surface contamination or impurities on the stent material not removed by cleaning processes. Results of SEM evaluation showed no evidence of contamination above the specified limits.

   c) **Mechanical Properties: Tensile Strength and Elongation**

   Tensile strength and elongation testing was performed on the stent raw material to determine the yield strength and percent elongation of the Liberté™ stent material. The yield strength and elongation of the Liberté™ stent met the product specifications.

   d) **Cyclic Potentiodynamic Polarization**

   Liberté™ stents were subjected to a test method that is closely harmonized with ASTM F2129-01; Standard Test Method for Conducting Cyclic Potentiodynamic Polarization Measurements to Determine the Corrosion Susceptibility of Small Implant Devices. The test was designed to demonstrate that finished stents exhibit corrosion and repassivation characteristics comparable to marketed stents for 316L type stainless steel implant material. The results indicated that the corrosion resistance of the device met product specifications.

2) **Stent Integrity Testing**

   a) **Metal to Artery Percentage**

   The metal surface coverage as a function of stent diameter was calculated by dividing the total vessel contact metal surface area of the stent structure by the surface area of the vessel at any given stent/vessel diameter. All sizes tested met the product specification.

   b) **Stent Foreshortening**

   Ten each of 2.75 x 8 mm, 3.5 x 8 mm, and 4.0 x 8 mm, and 5.0 x 12 mm Liberté™ stents were tested:. In addition, the sponsor tested five each of 2.75 x 32 mm, 3.5 x 32 mm, 4.0 x 12 mm, 4.0 x 32 mm, and 5.0 x 32 mm stents. Measurements of the stent constrained length were made and recorded for each stent at baseline and after inflation to 9 atm. The catheter was deflated and the length measurements repeated. All units tested met the product specification.

c) Stent Expansion Uniformity

Ten each of 2.75 x 32 mm stents and 4.0 x 32 mm stents were tested. Units were inflated to nominal stent diameters and measured at 3 points along the stent length after inflation. Measurements were averaged and compared to baseline measurements. All Liberté™ stents, expanded to nominal diameter, met the expansion uniformity specification for the WH and LV stents.

d) Stent Recoil

Fifteen each of 2.75 x 32 mm stents and 4.0 x 32 mm stents were tested. The system was inflated to nominal diameter and measurements were taken of the stent diameter at 3 locations along the stent. The system was then deflated and the three measurements were taken again. All of the tested Liberté™ stents met the product specification.

e) Stent Conformability Testing

Testing determined the conformability (axial flexibility) of the stent in its expanded state by characterization of the pure bending moment of the stent. Fifteen Liberté™ stents each of 3.5 x 16 mm and 5.0 x 16 mm stent sizes were tested. The amount of force necessary to create a curvature of 0.04 radian/mm was measured. All Liberté™ stents tested met product specifications.

f) Compression Resistance/Radial Hoop Strength

Testing was conducted to determine the radial resistance of the Liberté™ Stent to external compression. Fifteen Liberté™ stents each of 2.75 x 32 mm and 4.0 x 32 mm stent sizes were tested after expansion to nominal stent diameter. All Liberté™ stents tested exhibited a radial compression resistance of greater than the product specification.

g) Stent Expansion and Safety Margin

Testing was conducted to determine whether the deformation experienced by the stent undergoing expansion above the maximum rated diameter gives rise to stent fracture. Fifteen Liberté™ stents each of the 2.75 x 32 mm and 4.0 x 32 mm stent sizes were tested. The catheter was inflated until the stent was fully expanded to the designated over-expanded inner diameters, 4.25 mm for the WH stent, and 5.75 mm for the LV stent. The balloon was then deflated and the stent was carefully removed. No stents exhibited any fractures or structural damage when visually examined at 20X magnification following over-expansion.

h) Magnetic Resonance Imaging

The following statement is supplied in the Instructions for Use:

"The Liberté™ Stent has been shown to be MR safe at field strengths of 3 Tesla (T) or less, and a maximum whole body averaged specific absorption rate (SAR) of 2.0 W/kg for 15 minutes of MR imaging. The Liberté™ Stent

should not migrate in this MR environment. MR imaging at 3T or less may be performed immediately following the implantation of the Liberté™ Stent.

In this testing, the stent experienced a maximum temperature rise of 0.65 degrees C at a maximum whole body averaged SAR of 2 W/kg for 15 minutes of MR imaging. The temperature rise was observed to be similar for comparable bare metal overlapping stents (2 to 5 mm overlap at the ends). Heating has not been determined for fractured struts. MR imaging quality may be compromised if the area of interest is in the exact same area or relatively close to the position of the stent.

This stent has not been evaluated to determine if it is safe in MRI systems with field strengths greater than 3 T."

i) Stent Dimensional Verification

Testing was conducted to measure and optically inspect the stent to document that dimensional specifications do not deviate from the product specification. Twenty Liberté™ stents of each design (WH, 2.75-3.5 x 8 mm and LV, 4.0-5.0 x 8 mm) and twenty-three of each design (WH, 2.75-3.5 x 32 mm and LV, 4.0-5.0 x 32 mm) were inspected. The shortest and longest (8 and 32 mm) lengths of each design were evaluated to show that adequate manufacturing controls cover the range of stent sizes. All Liberté™ Stent designs tested met their specified requirements for dimensional criteria.

j) Finite Element Analysis

An in-depth finite element analysis (FEA) of the Liberté™ Stent was conducted to ensure that the implant conditions to which the stent will be subjected would not result in failure due to fatigue. The FEA evaluated the structural integrity of the Liberté™ stent when the stent was subjected to the expected load conditions generated in coronary arteries. Using FEA, a Goodman Analysis was performed to predict that all stent designs (2.75-3.5, and 4.0-5.0 mm) over-expanded to diameters of 4.25 and 5.75 mm respectively would not exhibit fatigue failure. The Goodman analysis showed that no fatigue failure will occur over 400 million cycles of loading and is within specification.

k) Ten Year Accelerated Pulsatile Fatigue Testing

Accelerated *in vitro* stent testing of approximately 10 years (400 million cycles) equivalent real time was conducted to ensure that the Liberté™ stent, when expanded to its largest intended diameters, will not show fatigue failure during simulated 10 year time span testing. The stents were expanded and then mounted on the inside of an appropriate sized simulated vessel. The stents were dynamically cycled for 400 million cycles. All stents were visually inspected at 400 million cycles and no signs of cracking, breaking or splitting were detected. In addition, 12 stents were analyzed by scanning

electron microscopy (SEM) at 400 million cycles. All tested stents were free from fatigue induced surface defects such as strut cracks and strut breakage. The Liberté™ stent met the 10 year accelerated fatigue resistance requirement of the product specification.

l) Stent Radiopacity

Testing was conducted to determine radiopacity of the Liberté™ Stent relative to other currently marketed stents. The stents were deployed in pig coronary arteries. Angiographic comparisons to competitive devices were made using fluoroscopy. The radiopacity of the Liberté™ Stent is comparable to other marketed stents.

Part 2 Pre-mounted System Testing

The following *in vitro* testing for the Liberté™ Monorail™ and Over-the-Wire Coronary Stent System evaluated performance characteristics and safety of the system. All test results indicated that the test specimens met or exceeded design specifications.

1) Liberté™ Coronary Stent System Testing

a) Balloon in a Stent Burst, Balloon Bonds and Inflation Lumen Integrity Testing

15 samples of the Liberté™ CSS of the 2.75 x 8 mm, 5.0 x 32 mm and the longest length of every balloon diameter for each labeled rated burst pressure (RBP) were tested to burst and for conformance to statistical requirements.

All Liberté™ CSS met rated burst pressure. The stent and balloon burst results show statistically that with 95% confidence, 99.9% of the Liberté™ CSS will not experience balloon, shaft, or proximal or distal seal loss of integrity at or below the maximum recommended RBP. Also, all bonds and inflation lumens withstood pressurization to RBP without failure.

b) Stent Nominal Sizing, Distension and Compliance Labeling

Testing was conducted to verify that the distention characteristics of the Liberté™ Coronary Stent System meet the labeled specifications. A minimum of forty-five units from three lots of complete Liberté™ systems of each diameter and varying lengths were tested to verify the typical post deployment stent inner diameter (ID) compliance data.

In addition, 15 units each of all sizes were tested to verify average ID at nominal (9 atm). The stent sizing results verify that the Liberté™ Coronary Stent Systems meet the labeled compliance values.

c) Stent Deployment Testing

Testing was performed on the Liberté™ Coronary Stent System to determine the stent deployment pressure and the ability of the balloon to be withdrawn from the stent. Fifteen samples of each diameter (in shortest and longest lengths) of the Liberté™ delivery system were tested. All Liberté™ Coronary

Stent Systems met the labeled deployment specification of ≤132 psi (9 atm) and there were no problems noted withdrawing the balloon from the deployed stent.

d) Balloon Inflation and Deflation Testing

Fifteen (15) each of representative sizes of the Liberté™ MR and OTW CSS were tested for inflation and deflation. All samples met specifications.

e) Repeat Balloon Inflation

Thirty samples each of the 2.75 x 8 mm, 2.75 x 32 mm, 4.0 x 8 mm, 4.0 x 32 mm 5.0 x 12 mm, and 5.0 x 32 mm Liberté™ CSS were tested to determine the ability of the balloon to withstand repeat balloon inflation. The stent/balloon burst results show statistically that, with 95% confidence, 90% of the catheters will not experience balloon, shaft, or proximal/distal seal loss of integrity at or below the maximum recommended rated balloon burst pressure.

f) Stent/Balloon Crossing Profile

Fifteen Liberté™ stent delivery systems of the shortest and longest stent length for each diameter were tested to determine the deflated stent/balloon profile. All samples met the product specification.

g) Shaft Diameters

The proximal and distal shaft components used for Liberté™ CSS are identical to those used for the Express2™ CSS, therefore the data received from the testing completed on the Express2™ was leveraged to support the Liberté™ CSS. Fifteen each of the Express2™ MR and Express2™ OTW 2.75 x 8 mm and 4.0 x 32 mm were tested for shaft diameters. In addition, fifteen each of representative sizes of the Liberté™ MR and OTW CSS were measured for distal tip diameters.

The Express2™ Coronary Stent Systems proximal shaft and distal shaft diameters met the specification. The Liberté™ CSS distal tip diameters also met the specification and were comparable to currently marketed stent delivery systems.

h) Pre- and Post-Deployment Catheter Withdrawal into a Guide

Fifteen each of the 4.0 x 32 and 5.0 x 32 mm Liberté™ CSS were tested for guide catheter withdrawal. Fifteen each of the 3.5 x 32 and 5.0 x 32 mm Liberté™ CSS were tested for balloon withdrawal in a stent. The catheter withdrawal forces were less than the specified maximum for all samples tested. The balloon withdrawal forces were less than the specified maximum for all samples tested.

i) Stent Securement Force Testing

Testing was conducted to assess the stent securement of the Liberté™ stent on the delivery system.

Fifteen Liberté™ as-manufactured devices, of the smallest and largest diameters, and the longest and shortest stent lengths for each type stent (2.75-3.5 mm and 4.0-5.0 mm) were tested for stent securement. The force required to dislodge the stent off the delivery system was measured. All of the devices met the stent securement specification.

Thirty-eight Liberté™ CSS of each of the following diameters were tested post-conditioning : 2.75 x 32 mm, 3.5 x 32 mm, 4.0 x 32 mm and 5.0 x 32 mm. Post-conditioning securement testing assessed the force to displace a crimped stent from its delivery system after tracking through a tortuous artery model. The units met the specification criterion with 90% confidence and 90% reliability.

A minimum of five Liberté™ and (5) Express2™CSS of each of the following diameters were tested for non-coaxial withdrawal from a guide post tracking: 2.75 x 8 mm, 4.0 x 8 mm, 2.75 x 32 mm, 4.0 x 32 mm, 3.5 x 8 mm, 5.0 x 12 mm, 3.5 x 32 mm, 5.0 x 32 mm. Liberté™ CSS were non-coaxially withdrawn into a guide catheter at a 45º angle following tracking through a tortuous artery model. The requirement was for Liberté™ to be superior to Express2™ with 90% confidence. The Liberté™ units met the product specification requirement for non-coaxial post-conditioning stent securement testing.

j) System Device Tracking

Testing was conducted to demonstrate that the tracking force of the Liberté™ CSS through a simulated artery is comparable to currently marketed devices. Ten each of the 3.0 x 16 mm and 4.0 x 16 mm Liberté™ MR and OTW and ten each of the same size Express2™ MR and OTW CSS were tested. The Liberté™ CSS were inserted over a 0.014" guide wire and into a guide catheter and simulated artery until the stent and balloon fully exited the distal end of the guide catheter. The guide wire was pushed distal to the distal end of the simulated artery and securely fastened. The catheter was then advanced through the artery while measuring the peak force.

The Liberté™ units were statistically equivalent to or better than the Express2™ units.

k) Full Unit Tensile Test

Liberté™ CSS use the same shafts and bonds as the Express2™ CSS, therefore Express2™ full unit catheter tensile testing data was leveraged to support the Liberté™ CSS. Fifteen each of the 2.25 x 8 mm for Express2™ MR and OTW and 4.0 x 32 mm for Express2™ MR CSS were tested. Each catheter was submerged in a 37° C water bath for a minimum of two hours and then removed for testing. The distal end of the catheter was clamped and a force gauge was connected to the manifold of the catheter. The catheter was

then pulled until failure and the maximum load from the force gauge was recorded. All Express2™ CSS tested met the minimum full unit catheter tensile strength specification.

l) Packaging

The packaging configuration for the Liberté™ MR and OTW CSS are identical to that used for the Express2™ MR and OTW CSS (P020009). Therefore, this test summary reported Express2™ data. Testing was conducted to determine the break free force required to dislodge the Express2™ manifold from its protective hoop and to determine the force required to remove the Express® stent delivery system from its protective hoop. Fifteen of the 5.0 x 32 Express2™ MR and Thirty of the 5.0 x 32 mm Express2™ OTW units were tested. All Express2™ delivery systems were able to be removed from their protective hoop without difficulty and without any damage imparted to any of the representative systems. All test units met their required specifications.

C. Animal Testing

The following *in-vitro* tests were performed in accordance with the FDA Guidance for the Submission of Research and Marketing Applications for Interventional Cardiology Devices, May 1994.

1. GLP Study to Evaluate the Performance and Vascular Response of the Liberté™ Stent in a Porcine Heart Model at 30 Days

The objective of the study was to evaluate the Liberté™ MR Coronary Stent System device performance and physiologic characteristics during the implant procedure, and cardiovascular stent patency and histologic response to the bare (uncoated) stainless steel Liberté™ stent in a domestic swine coronary-artery model at 30 days post procedure. Twelve Liberté™ stents were implanted in non-diseased coronary arteries of six swine. The Liberté™ stent showed no mortality or thrombus, and had complete endothelialization with no extensive inflammatory infiltrates. A well organized neointima was formed. The medial area was stable, and wide lumen patency was maintained, with stenosis rates of <15% by angiographic assessment. The Liberté™ stent did not cause significant injury or inflammation.

2. GLP Study to Evaluate the Performance and Vascular Response of the Liberté™ Stent in a Porcine Heart Model at 180 Days

The objective of the study was to determine device performance and histologic response to the bare (uncoated) Liberté™ stent in a domestic swine coronary-artery model at 180 days post procedure. Ten Liberté™ stents were implanted, using MR delivery systems, in non-diseased coronary arteries of ten swine for evaluation at a 180-day study endpoint. Implantation of the bare Liberté™ Coronary Stent in a non-diseased swine model at 180 days was not associated with thrombus, excessive inflammation, or clinically significant neointimal formation. Morphometric data and

SEM assessments obtained from implantation of the Liberté™ stent were within usual and expected responses for this animal model and study endpoint.

3. Performance Evaluation of the Liberté™ CSS

The objective of the study was to evaluate the acute deliverability and deployment characteristics of the Liberté™ MR and OTW CSS in porcine arteries. Ten each of the Liberté™ MR and OTW CSS were deployed in porcine arteries. Performance characteristics of the delivery systems were evaluated post stent delivery. Comparison of OTW and MR delivery systems to deliver Liberté™ stents into porcine coronary arteries demonstrated acceptable performance. There were no statistically significant differences in performance found between the Liberté™ MR and OTW stent delivery systems.

IX. POTENTIAL ADVERSE EFFECTS

A. Potential Adverse Events

Adverse events (in alphabetical order) which may be associated with the use of a coronary stent in native coronary arteries:

- Acute myocardial infarction
- Arrhythmias, including ventricular fibrillation (VF) and ventricular tachycardia (VT)
- Death
- Dissection
- Drug reactions to antiplatelet agents/contrast medium
- Emboli, distal (air, tissue or thrombotic emboli)
- Emergent Coronary Artery Bypass Surgery
- Hematoma
- Hemorrhage, requiring transfusion
- Hypotension/Hypertension
- Infection and/or pain at the access site
- Ischemia, myocardial
- Perforation or rupture
- Pseudoaneurysm, femoral
- Restenosis of stented segment
- Spasm
- Stent embolization
- Stent thrombosis/occlusion
- Stroke/cerebrovascular accident (CVA)/transient ischemic attack (TIA)
- Total occlusion of coronary artery

B. Observed Adverse Events

A total of 200 patients were enrolled in the ELECT Clinical Study, a prospective, multi-center, single arm registry. The primary objective of the study was to demonstrate equivalency of 30-Day Major Adverse Cardiac Events (MACE) for the Liberté™ CSS

compared to a historical control made up of patients who were treated with the uncoated Express® Coronary Stent System (Express) in the TAXUS IV-SR Trial. The historical control consists of 519 patients (excluding those receiving only a 2.5mm Express® stent) of the 652 randomized to the uncoated, bare metal Express® stent.

Table 6 presents the major clinical events observed in the BSC ELECT Clinical Study through 30 days post-stenting procedure.

Table 6. Principal Adverse Events: In-Hospital vs Out-of-Hospital

Event	Liberté™ Stent to 30 days	Express® Stent to 30 days
In-Hospital		
MACE	0.5% (1/200)	2.1% (11/519)
Death	0.0% (0/200)	0.4% (2/519)
Myocardial Infarction	0.5% (1/200)	2.1% (11/519)
Q-wave	0.0% (0/200)	0.2% (1/519)
Non Q-wave	0.5% (1/200)	1.9% (10/519)
Target Vessel Revascularization (TVR)	0.0% (0/200)	0.2% (1/519)
Target Lesion Revascularization (TLR)	0.0% (0/200)	0.2% (1/519)
TVR, non-target lesion	0.0% (0/200)	0.0% (0/519)
TVR, CABG	0.0% (0/200)	0.2% (1/519)
CVA	1.0% (2/200)	0.2% (1/519)
Stent Thrombosis (acute/in-hospital)	0.0% (0/200)	0.4% (2/519)
Out-of-Hospital		
MACE	0.0% (0/200)	0.2% (1/517)
Death	0.0% (0/200)	0.2% (1/517)
Myocardial Infarction	0.0% (0/200)	0.0% (0/517)
Q-wave	0.0% (0/200)	0.0% (0/517)
Non Q-wave	0.0% (0/200)	0.0% (0/517)
Target Vessel Revascularization (TVR)	0.0% (0/200)	0.0% (0/517)
Target Lesion Revascularization (TLR)	0.0% (0/200)	0.0% (0/517)
TVR, non-target lesion	0.0% (0/200)	0.0% (0/517)
TVR, CABG	0.0% (0/200)	0.0% (0/517)
CVA	0.0% (0/200)	0.2% (1/517)
Stent Thrombosis (sub-acute/<30 days)	0.0% (0/200)	0.2% (1/517)

Numbers are % (Count/Sample Size).

MACE: Major Adverse Cardiac Events comprised of Cardiac Death, MI and TVR.

TVR: Target Vessel Revascularization, defined as Ischemia-driven repeat percutaneous intervention of the target vessel or bypass surgery of the target vessel. A TVR will be considered as ischemia-driven if the target vessel diameter stenosis is ³50% by QCA and any of the following are present:

- the patient had a positive functional study corresponding to the area served by the target vessel;
- ischemic ECG changes at rest in a distribution consistent with the target vessel;
- ischemic symptoms referable to the target lesion.

Primary endpoint of BSC ELECT registry is 30-Day MACE

X. SUMMARY OF CLINICAL STUDIES

BSC ELECT Clinical Trial

Objective: To evaluate the safety and efficacy of the Liberté™ Coronary Stent System for the treatment of single *de novo* or restenotic (from a non-implantable percutaneous procedure) lesions in native coronary arteries.

Conclusion: The BSC ELECT registry demonstrated the 30-Day safety and efficacy of the Liberté™ Stent for treatment of patients with de novo or restenotic lesions in native coronary arteries.

Design: A multi-center, prospective, single arm registry was conducted at 20 U.S. sites enrolling 200 patients. Patients were 18 years of age or older with angina pectoris or functional ischemia undergoing elective treatment of a single de novo or restenotic lesion (from a non-implantable percutaneous procedure) in a native coronary artery. Eligible patients had visually estimated stenosis >50% and <100% located in a lesion < 28mm in length with a reference vessel >2.75mm and <4.0mm in diameter.

Endpoints: The primary endpoint for the BSC ELECT registry was Major Adverse Cardiac Event rate defined as the composite of cardiac death, Q-wave and non-Q-wave myocardial infarction, and target vessel revascularization through 30 days. The primary endpoint was analyzed on an intent-to-treat basis, defined as patients who had the study device introduced into the guide catheter. The secondary endpoints, including technical success, clinical procedural success, stent thrombosis rate, and serious bleeding and vascular complications were also analyzed on an intent-to-treat basis.

All patients received the hospital's standard anti-coagulation regimen for coronary stent implantation. After the procedure, patients received aspirin indefinitely and clopidogrel or ticlopidine for 30 days. Follow-up includes a 30-day office visit (primary endpoint) followed by clinical assessments at 6 and 12 months. All patients were required to have angiographic follow-up at 6-months.

Demographics: Baseline characteristics for the BSC ELECT registry indicated 67.5% were males with an average age of 62.0 years (range 35 to 90 years), 29.5% had diabetes requiring medication, 64.5% had known hyperlipidemia requiring medication, 21.0% are known current smokers and 73.5% had known hypertension requiring medication. In comparison to the Express® Stent population, the Liberté™ Stent population contained smaller proportions of patients with known CHF (3.0% vs. 7.5%), CCS angina class 4 (2.5% vs. 8.3%), silent ischemia (8.5% vs. 16.4%), and known family history of CAD (40.5% vs. 58.4%). The Liberté™ Stent population had a higher proportion of patients with CCS angina class 1 (12.5% vs. 7.5%). The Liberté™ Stent group represents a lower-risk patient population.

Methods: Clinical follow-up was conducted in-hospital and at 30 days post-procedure. Angiographic data was collected and assessed by quantitative analysis at a designated

core laboratory. An independent Clinical Events Committee adjudicated major adverse clinical events and stent thrombosis.

Results: In the BSC ELECT registry, the 30 Day MACE rate was 0.5% (1/198). The 30-Day MACE rates are 0.5% (1/198) and 2.3% (12/519) for the Liberté™ Stent and Express® Stent group, respectively, for a difference of -1.8% and an exact upper one-sided 95% confidence bound of 1.01%. Since the upper 95% confidence bound of the difference is less than the pre-specified equivalence limit delta of 4.0%, the null hypothesis of inferiority is rejected in favor of the alternative hypothesis of non-inferiority. However, this conclusion could not be statistically adjusted for all observed differences in demographics and baseline risk characteristics between the Liberté™ Stent and Express® Stent groups due mainly to the single observed MACE in the Liberté™ Stent group. That is, if it were possible to adjust for all observed baseline differences related to risk of MACE, the alternative hypothesis of noninferiority of the Liberté™ Stent to the Express® Stent may no longer hold. The Principal Safety and Effectiveness results are presented in the table below. The Liberté™ Stent and Express® Stent groups also had comparable rates of stent thrombosis, serious bleeding complications, serious vascular complications, and cerebral vascular events. All patients enrolled in the BSC ELECT trial received a Liberté™ Stent. A clinical procedural success rate of 99.5% (199/200) correlates with the single reported MACE. The technical success rate of 99.5% (199/200) includes one initial Liberté™ Stent attempted (2.75mm x 16mm) that could not cross the target lesion; however, two 2.75mm x 8mm Liberté™ Stents were successfully implanted.

Table 7. BSC Elect Principal Safety and Effectiveness Results through 30 Days

	Liberté™ Stent (N=200)	Express® Stent (N=519)	Difference [95% CI]
Effectiveness Measures			
Clinical Procedural Success	99.5% (199/200)	97.5% (506/519)	2.0% [-0.7%, 3.9%]
Technical Success	99.5% (199/200)	97.7% (507/519)	1.8% [-0.7%, 3.6%]
30-Day Results			
30-Day MACE	0.5% (1/200)	2.3% (12/519)	-1.8% [-3.6%, 0.7%]
Cardiac Death or MI	0.5% (1/200)	2.3% (12/519)	-1.8% [-3.6%, 0.7%]
Cardiac Death	0.0% (0/200)	0.6% (3/519)	-0.6% [-1.7%, 1.4%]
MI	0.5% (1/200)	2.1% (11/519)	-1.6% [-3.4%, 1.0%]
Q-Wave MI	0.0% (0/200)	0.2% (1/519)	-0.2% [-1.1%, 1.7%]
Non-Q-Wave MI	0.5% (1/200)	1.9% (10/519)	-1.4% [-3.1%, 1.0%]
TVR, Overall	0.0% (0/200)	0.2% (1/519)	-0.2% [-1.1%, 1.7%]
TLR Overall	0.0% (0/200)	0.2% (1/519)	-0.2% [-1.1%, 1.7%]
TLR, PCI	0.0% (0/200)	0.2% (1/519)	-0.2% [-1.1%, 1.7%]
TLR, CABG	0.0% (0/200)	0.2% (1/519)	-0.2% [-1.1%, 1.7%]
Non-TLR Overall	0.0% (0/200)	0.0% (0/519)	0.0% [-0.7%, 2.0%]
Non-TLR, PCI	0.0% (0/200)	0.0% (0/519)	0.0% [-0.7%, 2.0%]
Non-TLR, CABG	0.0% (0/200)	0.0% (0/519)	0.0% [-0.7%, 2.0%]
Safety Measures			
In-Hospital Stent Thrombosis	0.0% (0/200)	0.4% (2/519)	-0.4% [-1.4%, 1.7%]
Out-of-Hospital Stent Thrombosis to 30 Days	0.0% (0/200)	0.2% (1/517)	-0.2% [-1.1%, 1.7%]
In-Hospital MACE	0.5% (1/200)	2.1% (11/519)	-1.6% [-3.4%, 1.0%]
Out-of-Hospital MACE to 30 Days	0.0% (0/200)	0.2% (1/517)	-0.2% [-1.1%, 1.7%]
30-Day TVF	0.5% (1/200)	2.3% (12/519)	-1.8% [-3.6%, 0.7%]
Serious Bleeding Complications to 30 Days	1.5% (3/200)	0.8% (4/517)	0.7% [-0.8%, 3.8%]
Serious Vascular Complications to 30 Days	3.0% (6/200)	1.5% (8/517)	1.5% [-0.7%, 5.0%]
CVA to 30 Days	1.0% (2/200)	0.4% (2/517)	0.6% [-0.6%, 3.2%]

Numbers are % (Count/Sample Size). CI= Confidence Interval.
Difference = Liberté™-Express®. 95% CIs of the difference in proportions are exact. 95% confidence intervals were not adjusted for observed baseline differences in risk of MACE.
Clinical Procedural Success: using the study device to achieve an in-lesion diameter stenosis of <30% of the target lesion in the average of 2 near-orthogonal projections, as visually assessed by the physician, without the occurrence of in-hospital MACE (cardiac death, MI [Q-and non-Q-wave], repeat revascularization [percutaneous or CABG] of the target vessel).
Technical Success: successful delivery and deployment of the study device to the target lesion, without balloon rupture of the study device, stent embolization, or use of the study device outside the treatment strategy.
30-Day MACE: the proportion of patients who experience MACE up to 30 days post-procedure out of the patients who have either experienced a MACE up to 30 days post-procedure or who were MACE-free with last follow-up at least 23 days post-procedure.
Target Vessel Failure (TVF): any revascularization of the target vessel, or MI (Q-and non-Q-wave), or cardiac death that can not be clearly attributed to a vessel other than the target vessel.
Stent thrombosis:

- Clinical presentation of acute coronary syndrome with angiographic evidence of stent thrombosis

• Angiographic documentation of a complete occlusion (TIMI flow 0 or 1) of a previously successfully treated artery (TIMI flow 2 to 3 immediately after stent placement and DS <30%), and/or angiographic documentation of a flow limiting thrombus within or adjacent to a previously successfully treated lesion
• Acute MI of the distribution of the treated vessel
• Death within first 30 days (without other obvious cause) was considered a surrogate for stent thrombosis when angiography was not available

CVA – Transient ischemic attack or sudden onset of vertigo, numbness, aphasia, or dysarthria due to vascular lesions of the brain such as hemorrhage, embolism, thrombosis, or rupturing aneurysm, that persisted >24 hours.

Serious Bleeding Complications included: hemorrhage (upper GI bleed and GI not specified) and hematuria.

Gender Bias

Of the 200 patients enrolled in the ELECT clinical trial, 135 (67.5%) were male. The ratio of males to females in this study is consistent with other trials of coronary stents.

Univariate analyses were conducted which evaluated the effect of gender on the following clinical and angiographic outcomes at 30 days: Binary MACE, Binary MI. Gender was not significantly associated with the clinical outcomes. Since clinical outcomes were not associated with gender, these data demonstrated that gender was not an influencing factor on safety or effectiveness.

XI. CONCLUSIONS FROM CLINICAL AND NON-CLINICAL STUDIES

Non-clinical studies of the Liberté™ MR and OTW Coronary Stent System demonstrate that the devices are adequate for their intended use. Clinical study data demonstrates that the Liberté™ Coronary Stent System is both safe and effective for its intended use in patients followed through 30 days. A comparison of the 30-Day MACE rates for the Liberté™ stent group (0.5%, 1/198) and Express® stent group 2.3% (12/519), demonstrated non-inferiority of the Liberté™ Coronary Stent System to the Express® Stent System. However, this conclusion could not be statistically adjusted for all observed differences in demographics and baseline risk characteristics between the Liberté™ Stent and Express® Stent groups due mainly to the single observed MACE in the Liberté™ Stent group. That is, if it were possible to adjust for all observed baseline differences related to risk of MACE, the alternative hypothesis of noninferiority of the Liberté™ Stent to the Express® Stent may no longer hold.

XII. PANEL RECOMMENDATION

In accordance with the provisions of section 515(c)(2) of the act as amended by the Safe Medical Devices Act of 1990, this PMA was not referred to the Circulatory Systems Panel, and FDA advisory committee, for review and recommendation because the information in the PMA substantially duplicates information previously reviewed by this panel.

XIII. CDRH DECISION

CDRH issued a letter to Boston Scientific Scimed, Inc. on February 3, 2005 advising that the PMA was approvable subject to changes in the labeling and acceptable results from inspections of the manufacturing facilities. The applicant provided the required changes in the labeling and the applicant's manufacturing facilities were inspected on September 7 and September 16, 2004 and were found to be in compliance with the Quality System Regulation (21 CFR 820). CDRH approved this PMA application on April 12, 2005. To evaluate the longer-term outcomes associated with the Liberté™ stent, the sponsor was asked to collect and report to the Agency clinical outcomes through six months post-procedure on at least 80% of the patients enrolled in the ELECT study. When appropriate or as requested by FDA, the sponsor should submit a PMA supplement requesting approval to update the IFU to include these data.

XIV. APPROVAL SPECIFICATIONS

Directions for Use: See the labeling.

Hazards to Health from Use of the Device: See Indications, Contraindications, Warnings, Precautions and Adverse Events in the labeling.

Postapproval Requirements and Restrictions: See approval order.