Report On
Sequence IIIG Evaluation

Version IIIG VERSION 20030421

Conducted For
TSTSPON1

TSTSPON2

LABVALID	**V = Valid**
	I = Invalid
	N = Results Cannot Be Interpreted As Representative Of Oil Perfromance (Non-Reference Oil) And Shall Not Be Used For Multiple Test Acceptance

TSTOIL	**NR = Non-Reference Oil Test**
	RO = Reference Oil Test

Test Number					
Test Stand	STAND	**Stand Test**	STRUN	**Lab Test**	LABRUN
Oil Code	OILCODE				
Formulation/Stand	FORM				
Alternate Codes	ALTCODE1		ALTCODE2		ALTCODE3
EOT Date	DTCOMP		**EOT Time**		EOTTIME

In my opinion this test has been conducted in a valid manner in accordance with the latest draft of Sequence IIIG procedure and the appropriate amendments through the information letter system. The remarks included in the report describe the anomalies associated with this test.

OPVALID

Submitted By: SUBLAB

Testing Laboratory

SUBSIGIM

Signature

SUBNAME

Typed Name

SUBTITLE

Title

Form 2

Sequence IIIG

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Sequence IIIG

Form 3

Summary of Test Method

The Sequence IIIG Test is a fired-engine, dynamometer lubricant test for evaluating automotive engine oils for certain high-temperature performance characteristics, including oil thickening, varnish deposition, oil consumption, and engine wear. Such oils include both single viscosity grade and multi-viscosity grade oils that are used in spark-ignition, gasoline-fueled engines, as well as diesel engines.

The Sequence IIIG Test utilizes a 1996 model Buick 3800 Series II, water-cooled, 4 cycle, V-6 engine as the test apparatus. The Sequence IIIG test engine is an overhead valve design (OHV) and uses a single camshaft operating both intake and exhaust valves via pushrods and hydraulic valve lifters in a sliding-follower arrangement. The engine uses one intake and one exhaust valve per cylinder. Induction is handled by a modified GM port fuel injection system setting the Air-to-Fuel ratio at 15:1. The test engine is overhauled prior to each test, during which critical engine dimensions are measured and rated or measured parts (pistons, camshaft, valve lifters, etc.) are replaced.

The Sequence IIIG Test consists of a 10-minute operational check, followed by 100 hours of engine operation at moderately high speed, load, and temperature conditions. The 100-hour segment is broken down into five 20-hour test segments. Following each 20-hour segment, and the 10-minute operational check, oil samples are drawn from the engine. The kinematic viscosities of the 20-hour segment samples are compared to the viscosity of the 10-minute sample to determine the viscosity increase of the test oil.

The Sequence IIIG Test is operated at the following test states during the 100-hour portion of the test:

Parameter	Set Point
Engine Speed	3600 r/min
Engine Load	250 N-m
Oil Filter Block Temperature	150 °C
Coolant Outlet Temperature	115 °C
Fuel Pressure	365 kPa
Intake Air Temperature	35 °C
Intake Air Pressure	0.05 kPa
Intake Air Dew Point	16.1 °C
Exhaust Back Pressure	6 kPa
Engine Coolant Flow	160 L/min
Breather Tube Coolant Flow	10 L/min
Air-to-Fuel Ratio	15.0:1
Breather Tube Coolant Outlet Temperature	40 °C

SEQUENCE IIIG
FORM 4

TEST RESULT SUMMARY

Lab	LAB	**Oil Code**	OILCODE
Stand	STAND	**Test No.**	STAND -- STRUN -- LABRUN
Laboratory Oil Code		LABOCODE	
Formulation Stand Code		FORM	

Date Started	DTSTRT	**Engine No.**	ENGINENO
Time Started	STRTTIME	**Fuel Batch**	FUELBTID
Date Completed	DTCOMP	**SAE Viscosity**	SAEVISC
Time Completed	EOTTIME	**TMC Oil Code**	IND
Test Length	TESTLEN		

Pass/Fail Results						
	Viscosity Increase (%)	**Average Cam + Lifter Wear (µm)**	**Average Weighted Piston Deposits (merits)**	**Average Piston Skirt Varnish (merits)**	**Number of Hot-Stuck Rings**	**Oil Consumption (L)[B]**
Original Units	PVIS	ACLW	WPD	APV	HSTUKT	OILCON
Transformed Results	TPVIS	TACLW				
Industry Correction Factor	PVIS_CF	ACLW_CF	WPD_CF	APV_CF		
Corrected Transformed	PVIS_COR	ACLW_COR				
Severity Adjustment	PVIS_SA	ACLW_SA	WPD_SA	APV_SA		
Final Transformed Result	TPVISFNL	TACLWFNL				
Final Original Unit Result	PVISFNL	ACLWFNL	WPDFNL	APVFNL		

Additional Results					
Oil Consumption Hours, h [B]	OCONHRS	**Average Oil Ring Plugging, %**	ORPAVG		
Maximum Cam + Lifter Wear,	MCLW	**Number of Cold-Stuck Rings**	CSTUKT		
MRV Temperature, °C	MRVTEMP	**MRV Result, cP**	MRV	**Yield Stress, cP**	YSTRESS

Most Recent Stand Reference Oil Test History[C]			
Test Number	RSTAND - RSTRUN - RLABRUN		
Oil Code ROILCODE			
Date Completed	RDTCOMP	**TMC Oil**	RIND
Final Viscosity Increase, %	RPVISFNL	**Fuel Batch**	RFUELBID
Final Average Piston Skirt Varnish, merits	RAPVFNL		
Final Average Cam + Lifter Wear, µm	RACLWFNL		
Final Maximum Cam + Lifter Wear, µm	RMCLWFNL		
Final Average Weighted Piston Deposit, merits	RWPDFNL		

[A]Reference Oil Tests Only
[B]Test Hours at which Oil Consumption was calculated
[C]Non-Reference Oil Tests Only

Sequence IIIG

Form 5

Operational Summary

Lab	LAB	**Oil Code**	OILCODE			
Stand	STAND	**Test No.**	STAND	-- STRUN	-- LABRUN	
Laboratory Oil Code		LABOCODE				
Formulation Stand Code		FORM				

	Parameter	Units	QI	EOT	Target	Average	Standard Deviation	Number of Samples	Number of BQD
Controlled Parameters	**Speed**	**r/min**	**0.000**	QRPM	**3600**	ARPM	SRPM	NRPM	BRPM
	Load	**Nm**	**0.000**	QLOAD	**250**	ALOAD	SLOAD	NLOAD	BLOAD
	Oil Filter Block	**°C**	**0.000**	QOTEMP	**150.0**	AOTEMP	SOTEMP	NOTEMP	BOTEMP
	Engine Coolant Out	**°C**	**0.000**	QCOLOUT	**115.0**	ACOLOUT	SCOLOUT	NCOLOUT	BCOLOUT
	Condenser Coolant Out	**°C**	**0.000**	QCCOLOU	**40.0**	ACCOLOUT	SCCOLOUT	NCCOLOUT	BCCOLOU
	Left Air-to-Fuel Ratio		**0.000**	QLAFR	**15.0**	ALAFR	SLAFR	NLAFR	BLAFR
	Right Air-to-Fuel Ratio		**0.000**	QRAFR	**15.0**	ARAFR	SRAFR	NRAFR	BRAFR
	Left Exhaust Back Pressure	**kPa**	**0.000**	QLEXBP	**6.0**	ALEXBP	SLEXBP	NLEXBP	BLEXBP
	Right Exhaust Back Pressure	**kPa**	**0.000**	QREXBP	**6.0**	AREXBP	SREXBP	NREXBP	BREXBP
	Intake Air	**kPa**	**0.000**	QINAIR		AINAIR	SINAIR	NINAIR	BINAIR
	Engine Coolant Flow	**L/min**	**0.000**	QCOLFLC	**160.0**	ACOLFLO	SCOLFLO	NCOLFLO	BCOLFLC

	Parameter	Units	Average	Standard Deviation	Number of Samples	Number of BQD
Non-controlled Parameters	**Oil Sump**	**°C**	AOSUMP	SOSUMP	NOSUMP	BOSUMP
	Pump Outlet Pressure	**kPa**	APOUTP	SPOUTP	NPOUTP	BPOUTP
	Gallery Pressure	**kPa**	AOILPRS	SOILPRS	NOILPRS	BOILPRS
	Engine Coolant In	**°C**	AECOLIN	SECOLIN	NECOLIN	BECOLIN
	Fuel Inlet	**°C**	AFUELIN	SFUELIN	NFUELIN	BFUELIN
	Intake Air	**°C**	AINAT	SINAT	NINAT	BINAT
	Intake Air Dew Point	**°C**	AINDEW	SINDEW	NINDEW	BINDEW
	Intake Vacuum	**kPa**	AINVAC	SINVAC	NINVAC	BINVAC
	Crankcase	**kPa**	ACCASEP	SCCASEP	NCCASEP	BCCASEP
	Fuel Pressure	**kPa**	APFUEL	SPFUEL	NPFUEL	BPFUEL

Oil Consumption Data						
Hours	**Initial Run-in**	OCONH0	OCONH0	OCONH0(	OCONH08(	OCONH1
Level (ml) low	OILLINI	OILLH(	OILLH(	OILLH(	OILLH(	OILLH1

NO_x Measurement			
Hours	NOXHH019	NOXHH04	NOXHH099
NO_x, ppm	NOX_H019	NOX_H049	NOX_H099

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Form 6

Used Oil Analysis Results

Lab	LAB	**Oil Code**	OILCODE				
Stand	STAND	**Test No.**	STAND	--	STRUN	--	LABRUN
Laboratory Oil Code		LABOCODE					
Formulation Stand Code		FORM					

Viscosity Increase Data (cST at 40°C)			
Hours	**Viscosity[A]**	**Change**	**Percent**
New Oil	VNEW		
Initial[B]	VINI		
VISTH020	VIS_H020	DVISH020	PVISH020
VISTH040	VIS_H040	DVISH040	PVISH040
VISTH060	VIS_H060	DVISH060	PVISH060
VISTH080	VIS_H080	DVISH080	PVISH080
VISTH100	VIS_H100	DVISH100	PVISH100
TESTLEN	VISEOT	DVISEOT	PVIS

Results of ICP Analysis of Used Oil			
Hours	**Iron**	**Copper**	**Lead**
Initial	FEWMINI	CUWMINI	PBWMINI
TST_H020	FEWMH020	CUWMH02(	PBWMH02(
TST_H040	FEWMH040	CUWMH04(	PBWMH04(
TST_H060	FEWMH060	CUWMH06(	PBWMH06(
TST_H080	FEWMH080	CUWMH08(	PBWMH08(
TST_H100	FEWMH100	CUWMH10(	PBWMH10(
TESTLEN	FEWMEOT	CUWMEOT	

[A] 8000 cSt is maximum allowable viscosity

[B] At end of leveling run

Cold Crank Simulator Results, D 5293	
Final Temperature, °C	CCSTEMP
Final Cold-Crank Simulator Viscosity, cP	CCS

Mini-Rotary Viscometer Results, D 4684	
MRV Temperature, °C	MRVTEMP
MRV Result, cP	MRV
Yield Stress, cP	YSTRESS

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Form 7

Valve Lifter And Camshaft Wear Results

Lab	LAB	**Oil Code**	OILCODE
Stand	STAND	**Test No.**	STAND -- STRUN -- LABRUN
Laboratory Oil Code		LABOCODE	
Formulation Stand Code		FORM	

Number	Camshaft Lobe, µm	Valve Lifter, µm	Cam & Lifter Wear, µm
1	CAMW01	LFTW01	CLW01
2	CAMW02	LFTW02	CLW02
3	CAMW03	LFTW03	CLW03
4	CAMW04	LFTW04	CLW04
5	CAMW05	LFTW05	CLW05
6	CAMW06	LFTW06	CLW06
7	CAMW07	LFTW07	CLW07
8	CAMW08	LFTW08	CLW08
9	CAMW09	LFTW09	CLW09
10	CAMW10	LFTW10	CLW10
11	CAMW11	LFTW11	CLW11
12	CAMW12	LFTW12	CLW12
Maximum	MAXCW	MAXLFTW	MCLW
Minimum	MINCW	MINLFTW	MINCLW
Average	AVGCW	AVGLFTW	ACLW

Sequence IIIG

Form 8

Summary Of Oil Ring Land Deposit Rating

LAB OILCODE
STAND STAND STRUN LABRUN

Lab		**Oil Code**			
Stand		**Test No.**	--	--	
Laboratory Oil Code		RLDRATER	RLDRTDT		
Formulation Stand Code					
Rater			**Rating Date**		

Piston	Oil Ring Land Deposit, Merits	% Chipped
	ORLD1	ORCHIP1
	ORLD2	ORCHIP2
1	ORLD3	ORCHIP3
2	ORLD4	ORCHIP4
3	ORLD5	ORCHIP5
4	ORLD6	ORCHIP6
5	ORLD	AVGORCHP
6		
Average		

Piston	% Oil Ring Plugging	Ring Sticking[A]	
		Hot-Stuck Rings	Cold-Stuck Rings
1	ORP1	HSTUK1	CSTUK1
2	ORP2	HSTUK2	CSTUK2
3	ORP3	HSTUK3	CSTUK3
4	ORP4	HSTUK4	CSTUK4
5	ORP5	HSTUK5	CSTUK5
6	ORP6	HSTUK6	CSTUK6
Total			
Average			

[A] Possible values T = top compression ring
B = bottom compression ring
O = oil ring
N = none

Sequence IIIG

Form 9

Summary Of Piston Deposits

Lab		**Oil Code**	LAB OILCODE
Stand		**Test No.**	-- STAND -- STRUN LABRUN
Laboratory Oil Code	STAND LABOCODE		
Formulation Stand Code			
Rater	FORM RLDRATER	**Rating Date**	RLDRTDT

Note: CRC Manual 14 used for ALL Ratings

NOTE: These are un-weighted ratings

	Grooves, merits			Lands, merits			Undercrown, merits
	1	**2**	**3**	**Crown**	**2**	**3**	
Piston 1							
Piston 2	G1P1	G2P1	G3P1		L2P1	ORLD1	UCP1
Piston 3	G1P2	G2P2	G3P2		L2P2	ORLD2	UCP2
Piston 4	G1P3	G2P3	G3P3		L2P3	ORLD3	UCP3
Piston 5	G1P4	G2P4	G3P4		L2P4	ORLD4	UCP4
Piston 6	G1P5	G2P5	G3P5		L2P5	ORLD5	UCP5
WF	**0.05** G1P6	**0.10** G2P6	**0.20** G3P6		**0.15** L2P6	**0.30** ORLD6	**0.10** UCP6

Note: These are unweighted ratings

	Piston Skirt Varnish, merits		
	Thrust	**Anti-Thrust**	**Average**
Piston 1			
Piston 2	PSVT1	PSVA1	PSVAV1
Piston 3	PSVT2	PSVA2	PSVAV2
Piston 4	PSVT3	PSVA3	PSVAV3
Piston 5	PSVT4	PSVA4	PSVAV4
Piston 6	PSVT5	PSVA5	PSVAV5
Average	PSVT6	PSVA6	PSVAV6
WF	PSVAAV	PSVTAV	APV **0.10**

PSVAVx = (PSVTx + PSVAx)/2 ***where x = Number of Piston***
PSVTAV = average of six Thrust Piston Skirt ratings.
PSVAAV = average of six Anti-Thrust Piston Skirt ratings.
APV = average of all 12 Piston Skirt ratings.

	Total Weighted Deposits, merits
Piston 1	WPD1
Piston 2	WPD2
Piston 3	WPD3
Piston 4	WPD4
Piston 5	WPD5
Piston 6	WPD6

WPDx = (WF*G1Px)+(WF*G2Px)+(WF*G3Px)+ (WF*L2Px)+ (WF*ORLDx)+(WF*UCPx)+(WF*PSVAVx)
where: x = Number of Piston
WF = Appropriate Weighting Factor (WF) for part, from table.

Average Weighted Piston Deposits, merits	WPD

WPD = (WPD1+WPD2+WPD3+WPD4+WPD5+WPD6)/6

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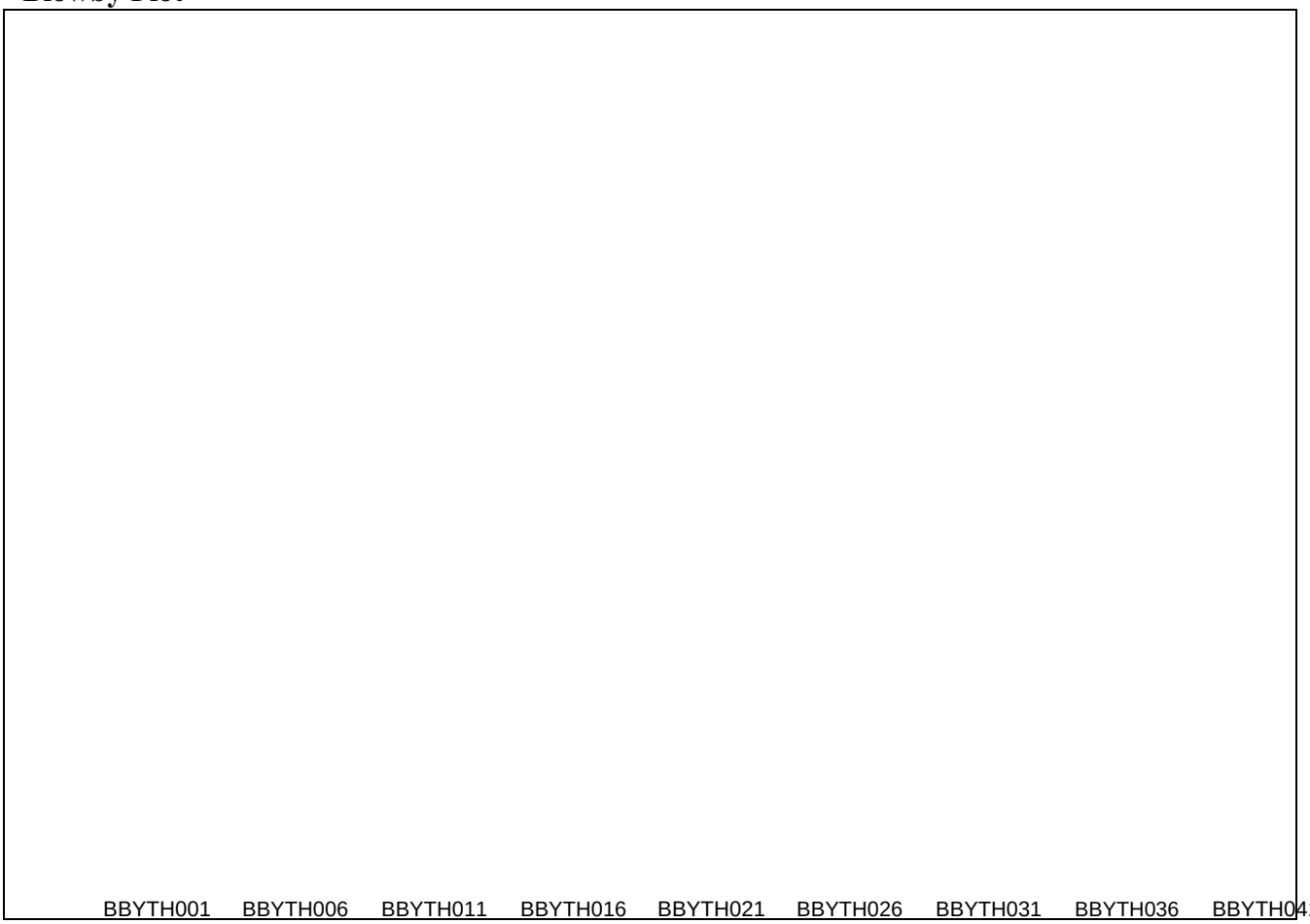
Form 10

Blowby Values & Plot

Lab		**Oil Code** LAB OILCODE	
Stand		**Test No.** STAND LABOCODE	STAND STRUN LABRUN -- --
Laboratory Oil Code		FORM	
Formulation Stand Code			

OWBYIM **Blowby Plot**



Test Hours	BLWBH001	BLWBH006	BLWBH011	BLWBH016	BLWBH021	BLWBH026	BLWBH031	BLWBH036	BLWBH041	BLWBH046
Blowby, L/min.	~~BBYTH051~~	~~BBYTH056~~	~~BBYTH061~~	~~BBYTH066~~	~~BBYTH071~~	~~BBYTH076~~	~~BBYTH081~~	~~BBYTH086~~	~~BBYTH091~~	~~BBYTH096~~
Test Hours										
Blowby, L/min.	BLWBH051	BLWBH056	BLWBH061	BLWBH066	BLWBH071	BLWBH076	BLWBH081	BLWBH086	BLWBH091	BLWBH096
Test Hours	BBYTH099									
Blowby, L/min.	BLWBH099	ABLOBY								

Form 11

Viscosity Increase Plot

Lab		**Oil Code**	
Stand		**Test No.**	-- --
Laboratory Oil Code			
Formulation Stand Code			

LAB
OILCODE
STAND
STAND STRUN LABRUN
LABOCODE
FORM

INIM

Sequence IIIG

Form 12

Hardware Information

Lab		**Oil Code**	LAB	OILCODE	
Stand		**Test No.**	STAND	-- STAND STRUN LABRUN	
Laboratory Oil Code		LABOCODE			
Formulation Stand Code		FORM			

Build Completion Date	BUILDDT	**Piston Batch (Code)**		PISTBAT
Block Serial Number	BLOCKSN	**Piston Size (Grade)**		PISTSIZI
Crankshaft Serial Number	CRANKSN	**Piston Ring Batch Code**		RINGCODE
Camshaft Serial Number	CAMSN	**Oil Filter Batch Code**		OILFIBAT
Cylinder Head Serial Number, Left	LHEADSN	**Intake Valve Seals Batch Code**		INVSLBAT
Cylinder Head Serial Number, Right	RHEADSN	**Valve Springs Batch Code**		VALSPBAT
Bearing Kit Serial Number	BRNGSN	**Lifter Serial Number**	**1**	LFTR1SN
Top Ring Gap, mils	TRINGGAP		**2**	LFTR2SN
Bottom Ring Gap, mils	BRINGGAP		**3**	LFTR3SN
			4	LFTR4SN
			5	LFTR5SN
			6	LFTR6SN
			7	LFTR7SN
			8	LFTR8SN
			9	LFTR9SN
			10	LFTR10SN
			11	LFTR11SN
			12	LFTR12SN

Sequence IIIG

Form 13

Downtime & Outlier Report Form

Lab		**Oil Code**	
Stand		**Test No.** LAB	-- OILCODE --
Laboratory Oil Code	STAND	STAND STRUN LABRUN	
Formulation Stand Code	LABOCODE FORM		

Number of Downtime Occurrences			
Test Hours	**Date**	**Downtime**	**Reasons**
		DWNOC	
DOWNR001	DDATR001	DTIMR001	DREAR001
DOWNR002	DDATR002	DTIMR002	DREAR002
DOWNR003	DDATR003	DTIMR003	DREAR003
DOWNR004	DDATR004	DTIMR004	DREAR004
DOWNR005	DDATR005	DTIMR005	DREAR005
DOWNR006	DDATR006	DTIMR006	DREAR006
		TOTLDOWN	
		TOTCOM	
			Total Downtime (hours) – Maximum allowable downtime: 24 hours

Other Comments	
Number of Comment Lines	
OCOMR001	
OCOMR002	
OCOMR003	
OCOMR004	
OCOMR005	
OCOMR006	
OCOMR007	
OCOMR008	
OCOMR009	
OCOMR010	
OCOMR011	
OCOMR012	
OCOMR013	
OCOMR014	

Sequence IIIG

Form 13A

Downtime & Outlier Report Form

Lab		**Oil Code**	
Stand		**Test No.** LAB	-- OILCODE
Laboratory Oil Code	STAND	STAND STRUN LABRUN	
Formulation Stand Code	LABOCODE FORM		

Number of Downtime Occurrences			
Test Hours	**Date**	**Downtime**	**Reasons**
			DWNOC
DOWNR007	DDATR007	DTIMR007	DREAR007
DOWNR008	DDATR008	DTIMR008	DREAR008
DOWNR009	DDATR009	DTIMR009	DREAR009
DOWNR010	DDATR010	DTIMR010	DREAR010
DOWNR011	DDATR011	DTIMR011	DREAR011
DOWNR012	DDATR012	DTIMR012	DREAR012
		TOTLDOWN	
		TOTLOUR	
OCOMR015			
OCOMR016			**Total Downtime (hours) – Maximum allowable downtime: 24 hours**

OCOMR017

Other Comments	
Number of Comment Lines	
OCOMR018	
OCOMR019	
OCOMR020	
OCOMR021	
OCOMR022	
OCOMR023	
OCOMR024	
OCOMR025	
OCOMR026	
OCOMR027	
OCOMR028	
OCOMR029	
OCOMR030	