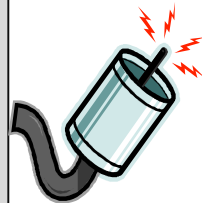




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**President's Message, by Joe Miller KJ8O**

The idea for my column this month came to me while listening to a concert by the children's choir before the start of Christmas Day church services, and the selection in particular was titled "Dona nobis pacem" or in English "grant us peace". Many people have the belief that the Latin language has outlived its usefulness, even though it is still used in both the medical and legal professions. Also, the effect of the Latin language is still evident in several modern languages (Italian, French and Spanish to name a few) and to some extent, English.

So what about CW? Although it has been almost eight years since the FCC has dropped CW requirements for all operating classes, the airwaves are still full of the dits and dahs as frequently heard in 1914 when the American Radio Relay League was first organized. And just like the Latin language, CW has had its effect on modern day amateur radio. For example, the term varicode probably was not in common use in 1914, but the more common letters in the alphabet, T, E and I are represented with shorter codes, while less common letters, X Y and J have longer codes. This is the same principal is used in PSK31, and as a result, slightly reduces the amount of time needed to send a message. Note that RTTU uses Baudot codes which are fixed in length.

Even though we will not be around in 2114, let us hope that Morse Code will not only still be viable, but will also continue to lead to further developments in this great hobby of ours.

And speaking of the ARRL Centennial Challenge, even though the event ended on December 31, there is still time to upload any logs into Logbook of the World as the deadline is January 15. Shortly afterwards, the league will rescore the log submissions and final results will eventually be announced. In the meantime, tentative scores are listed in this issue.

This month's meeting (held earlier) brought back on old friend, Jerry Begel, W9NPI, who will present his final instalment of the History of Telgraphy. In the words of my predecessor, bring a friend.

Some special mention this month goes out to four hams (in no particular order other than all were greatly appreciated).

Doug N8VY who performed admirably as OCARS Secretary, thank you for your service, and I wish all the best in your future endeavors.

Scott N2OPQ who will succeed Doug as secretary. Prior to that, Scott had also volunteered to serve as the new webmaster for the club webpage on QSL.net.

Dan KD8TXZ covered for me one week on running the OCARS net. I listened as much as I could that night and I can only echo the well wishes he received from everyone.

And of course, to Larry KB8POD who has covered for me on several occasions throughout the year.

So in closing, I hope every one of you has a happy and prosperous new year filled with good DX. Some exciting presentations are in the works, and 2015 looks to be an interesting, even if it will be a tough act to follow after the ARRL Centennial Events.

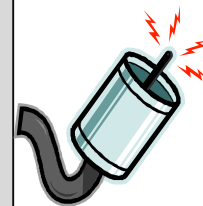
Thanks again.

73 de Joe, KJ8O, OCARS President

P.S. On occasion, we get requests to reprint articles. This month's was submitted by George WD8INW. Greg W8VIJ has another on deck for February.



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## ARRL Centennial Challenge and Worked All States update

Starting January 1 and ending at midnight on December 31 (that's 7:00 pm on New Years Eve in local time) the Centennial Anniversary special events did come to a close. The Centennial Challenge involved making contact with ARRL members and can range from one point for contact with a member, five points for contact with a volunteer examiner, to three hundred points for contact with the president of the ARRL. This also includes about 50 other categories of ARRL membership, and only one contact per band and mode combination is awarded points. As of January 14, the leaders within OCARS include:

• Ron W8RLS	69,444
• Joe KJ8O	38,368
• Tim K8NWD	24,742
• Fred W1SKU	7,460
• Ken W8KRS	6,751
• Jim K8ZZU	2,703
• Wayne N8KIM	3,839
• Doug N8VY	2,205
• Bob K8RGM	386
• Al K8SIX	121

The W1AW portable operations commenced on January 1 and also ended on December 31 and involved making contact with the W1AW stations that were activated for two one week periods during 2014 from each of the fifty states, as well as U.S. territories. As of January 14, leaders within OCARS includes:

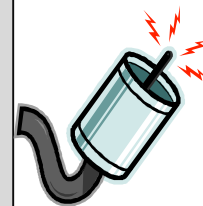
• Ron W8RLS	2,036
• Tim K8NWD	993
• Ken W8KRS	498
• Joe KJ8O	335
• Doug N8VY	222
• Fred W1SKU	188
• Wayne N8KIM	133
• Jim K8ZZU	11
• Bob K8RGM	2

Please note, these standings are as of January 14. The submission deal line was recently extended to January 22 to give the ARRL a chance to final scoring of the centennial challenge

The ARRL will be offering certificates of achievement to anyone scoring at least 1,000 points in the Centennial Challenge, as Worked All States certificate to anyone working all fifty. Please refer to [www.arrl.com](http://www.arrl.com) for more information.



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***Siren Testing:***

See you in March 2015, please stay tuned

**OCARS Meetings**

Tuesday, February 3, monthly meeting at 7:30, topic to be determined

Tuesday, March 3, monthly meeting at 7:30, N1MM and N3FJP contest software

Tuesday, April 7, monthly meeting at 7:30, topic to be determined

Tuesday, May 5, monthly meeting at 7:30, topic to be discussed

***Meeting location:***

Bethany Baptist Church, 1375 Hiller Rd., Waterford  
doors open at 7:00, meeting begins at 7:30

***Social Gathering:***

Wednesday 10:15 – 11:30 am, Village Place restaurant  
S.W. corner of Dixie Highway and Andersonville Rd., Waterford

***Officers and Directors:***

President:	Joe Miller KJ8O	Directors:	Tim Pepper K8NWD
Secretary:	Doug Basberg N8VY		Al Bailey K8SIX
Treasurer:	John Eldred N8FNN		Fred Holmes W1SKU
Trustee:	Brad Nowak N8SNM		Jim Vigne KB8TXZ

***OCARS Net:***

8:00 pm (local time) on the Clarkston Repeater, 146.840 MHz, p.l. tone 100 Hz,  
Joe KJ8O is net control and welcomes participation from all area hams.

***Checkins:***

Dates are local time, Monday evenings, with number of check-ins:

December 1,	<u>21</u>	December 22,	<u>16</u>
December 8,	<u>19</u>	December 29,	<u>18</u>
December 15,	<u>19</u>		

***Website:***

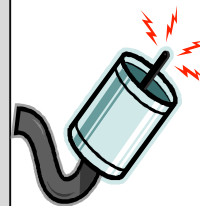
[www.qsl.net/w8tno](http://www.qsl.net/w8tno) maintained by webmaster Scott Craig N2OPQ

***Contact information:***

[w8tno.ocars@gmail.com](mailto:w8tno.ocars@gmail.com) or [kj8o.ham@gmail.com](mailto:kj8o.ham@gmail.com) (for an immediate response)



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**Upcoming Hamfests**

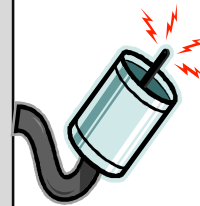
- Feb 7, 2015      Hiawatha Amateur Radio Association (HARA) Swap, Negaunee  
<http://www.qsl.net/k8lod/>
- Feb 14, 2015      Cherryland Amateur Radio Club, Traverse City  
[http://cherrylandarc.com/?page\\_id=56](http://cherrylandarc.com/?page_id=56)
- Feb 15, 2015      Livonia ARC, Livonia  
<http://www.livoniaarc.com/index.php?page=swapshop>
- Mar 14, 2015      Crossroads Hamfest (new location in Kalamazoo)  
<http://www.w8df.com/index.php?content=hamfest>

**Upcoming Contests**

- February 21-22      ARRL International DX – CW
- March 7-8      ARRL International DX – SSB
- April 18-19      Michigan QSO Party



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**OCARS Meeting Minutes for December 2, 2014**  
**Douglas S. Basberg N8VY, secretary**

Members socialized from 7-7:30pm

Meeting called to order at 7:31pm by Joe KJ8O, president.

**Business Meeting**

The November OCARS minutes in the Feedline was moved to accept by Greg, W8VIJ and seconded by Tim, K8NWD and accepted unanimously.

The November treasurer's report was made by John, N8FNN. Doug, N8VY moved to accept and Mike, KB3QIY seconded. The treasurer's report was accepted unanimously.

Joe, KJ8O, announced the April QSO Party for Michigan will include special recognition of the ten counties in Michigan named for members of the Andrew Jackson cabinet. Joe will have more information on this soon when it becomes available.

Joe, KJ8O, told us that hams licensed in technician class before 1987 have an opportunity to upgrade to the general class license. Prior to 1987, technicians took the same written test that general class examinees are now taking, so if someone held a technician license then, all they have to do is complete the application form, pay \$15, and bring some proof of their earlier license., either their original license or an amateur radio call sign book.

**OCARS Officer Elections**

Joe called for nominations for officers from the floor. That was the most quiet moment of any meeting I have attended since I joined three years ago. I hope the membership will consider that OCARS can only exist if the members support it. Joe, KJ8O nominated Scott Craig, N2OPQ for secretary. Doug, N8VY (the current secretary) seconded the motion. The slate of officers is Joe Miller, KJ8O for president, John Eldred, N8FNN for treasurer, and Scott Craig for secretary. The slate was accepted unanimously. We are all highly obliged to these members that volunteer their time to make OCARS successful.

Charles Kamachos, KD8HNL was the winner of the 50-50 drawing and he donated his winnings to OCARS. Thank you Charles.

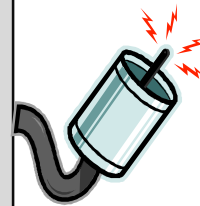
OCARS net is on Monday at 8pm on 146.840 PL 100.

Jim, KB8TXZ has knit OCARS shirts for \$23.00 for sale. Place orders with Jim.

Joe, KJ8O adjourned the meeting at 9:40pm



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SWR: Myths, Mysteries, Solutions  
By Steve Bowen N7CPU

I will explain some of the often misunderstood facts about antenna SWR at HF and uncover some popular misconceptions.

The questions are; what really happens in a mismatched antenna system, how much power is radiated and what happens to the rest?

Is high SWR always bad? Will high SWR blow up your transmitter and how does an antenna tuner really work?

There are many books written about transmission lines and antennas and the mathematics dealing with complex antenna impedance and transmission line behaviour are fairly complex, I will attempt to explain the basics while keeping the article a 'math free zone'. If you want to get into the details there is a lot of information in the ARRL handbooks.

So what happens in the real world?

Step 1: RF energy from your transceiver travels down your feedline cable (usually coax cable these days) towards the antenna. On the way some of the energy is lost as heat due to the cable loss of the coax cable. Better coax types have less loss. Coax cable loss is measured in decibels (dB) and is greater at higher frequencies. So a coax cable that is OK for HF 1-30MHz may be poor at VHF or UHF frequencies.

Step 2: When the energy reaches the antenna, some of the energy is radiated, a very, very, small amount is absorbed by antenna components and dissipated as heat, and the rest is reflected back down the feedline cable towards the transmitter again. There is no loss due to the reflection; 99.9+% of the system losses are due to the coax. If the antenna is a good match for the feedline and transmitter (i.e. has an impedance of around 50 Ohms) then most of the power will be radiated, which is good.

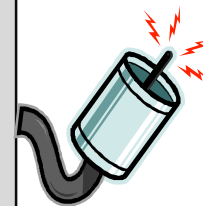
Step 3: The voltage of the RF energy travelling back towards the transceiver is not in the same phase as the RF voltage travelling towards the antenna. The addition of the two voltages causes high voltage (low current) and low voltage (high current) nodes at regular distances along the feedline cable. In extreme cases with high power transmitters this can cause voltage breakdowns or hot spots along the feedline. This regular pattern of voltage nodes is called a 'Voltage Standing Wave'. The ratio of the peak voltage to the minimum voltage is the 'Voltage Standing Wave Ratio' or VSWR usually shortened to SWR.

Step 4: Some of the RF energy reflected back towards the transceiver is lost as heat due to the cable loss of the coax cable.

Step 5: When the RF reaches the antenna tuner or the transceiver final stage, some energy is absorbed as heat but almost all of the energy is reflected back towards the antenna again! Contrary to popular opinion the RF power reflected back even from a very bad match such as



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an open or shorted feedline will NOT damage the final of your transceiver. I will explain what can cause your rig serious damage later, so keep reading.

Step 6: The energy reflected back towards the antenna joins the energy generated by your transmitter and the energy being reflected from the antenna, but again the phase is different and this affects the standing wave. The effect is small because having lost energy on the way to the antenna, and then on the way back to the transmitter the RF power of the now twice reflected wave is quite small. When the energy finally reaches the antenna (for the second time) it has been attenuated by the cable loss again. Again some of the energy is radiated and some is reflected... go to step 3 and repeat until all of the energy has either been lost as heat in feedline loss or radiated by the antenna.

Here is an example using values for a typical feedline loss of 1dB and an antenna with an SWR of 2:1.

100W is sent out from the transceiver. Just over 20W is lost due to the 1dB feedline cable loss so 80W reaches the antenna where due to the mismatch causing the 2:1 SWR around 70W is radiated and 10W is reflected back. By the time the 10W reflected signal reaches the transceiver through the 1dB feedline cable loss it has reduced to around 8W which is reflected back towards the antenna. When the 8W reaches the antenna it is down to around 6W. 5.6W of that is radiated and the remaining 0.4W is reflected back towards the transceiver again. So out of the 100W you originally put into the antenna feedline, about 75.6W is radiated, the rest is lost as heat, in the coax. Because of these multiple reflections, high SWR causes the feed line losses to be multiplied, so low loss feed line causes less power to be lost in a mismatched system than high loss feed lines.

What is Return Loss?

Engineers usually use Return Loss instead of SWR. Return loss is the difference, in dB, between forward and reflected power measured at any given point in an RF system and, like SWR, it does not vary with the power level at which it is measured. Return Loss has a fixed relationship to SWR but is expressed in dB which makes it easier to use in calculations. For the same reason, engineers often refer to RF power in dB relative a fixed level usually a milliwatt (dBm) or Watt (dBW), rather than using Watts. The lower the SWR is, the higher the Return Loss. For example an SWR of 2:1 is equivalent to 9.5dB RL and an SWR of 1.1:1 is equivalent to 26dB RL. A perfect (but unachievable) 1:1 SWR is equivalent to a Return Loss of infinity. In the real world an SWR better than 1.5:1 (RL=14dB) is acceptable and an SWR better than 1.2:1 (RL=21dB) is pretty good.

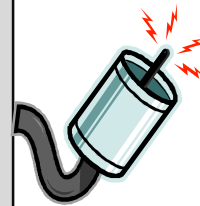
Most SWR meters do not actually measure the voltage maximum and minimum nodes along the transmission line. They actually measure the forward and reflected power, normally by rectifying the voltage across load resistors on a directional coupler, so in reality they are measuring the return loss. But as there is a known relationship between return loss and SWR the meter can be calibrated to display SWR. Cross needle SWR meters read forward power on one meter and reverse power on the other meter. The intersection of the two meters (where the pointers cross) is calibrated to show SWR or Return Loss, or both.

All antenna loads have either capacitive or inductive reactance in addition to resistance. The combination of the resistive load and the reactive load is the antenna (complex) impedance. This means that the load as seen at the transmitter looks like a combination of a resistance and an inductance or capacitance. In a 'good' well matched antenna the resistance will be close to 50 Ohms and the inductance or capacitance will be near zero. This is called





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resonance and is usually arranged to be in the center of the band or may be offset slightly towards the CW or SSB portions on the band. At the band edges the SWR is typically slightly higher, the resistance is slightly higher or lower than 50 Ohms and there may be a small amount of either capacitive or inductive reactance.

You can see from the earlier example that the 8W of reflected power that gets back to the transmitter will not cause any major problems so what can cause damage to your transceiver if you have high SWR? The problem is not the power reflected back from the mismatched load or antenna. In fact transmitting after failing to connect an antenna to your transceiver would cause 100% reflections but would probably not damage the transmitter finals (don't try this at home). But running the transceiver into a length of coax cable with a short circuit on the end, or a faulty antenna, non resonant antenna, or no antenna (open circuit) is exceptionally dangerous. The culprits are the standing wave and the complex impedance. Remember I said that the standing wave results in high voltage nodes at regular distances along the coax feedline? The voltage at these nodes is the (vector) sum of all of the signals being sent and reflected back and forwards along the cable. The voltage peaks could be very high. If due to the particular load impedance, RF frequency, and length of the transmission line (coax feedline cable), one of the voltage peaks happens to occur right at the transmitter end of the cable, there could be excessive RF voltage appearing at the transmitter output stage. This could cause flash over or RF breakdown across final transistors, inductors or capacitors. The risk of this is unpredictable you could get away with it 100 times on one frequency and then blow the rig at a different frequency. A voltage null at the transmitter end of the cable would cause high current to flow which could also damage the rig, but this situation is less dangerous than the high voltage event because it would probably trip the SWR protection in the rig.

Standing wave voltage is not the real baddy though; the other nasty is the complex impedance. As I said earlier all antenna loads have either capacitive or inductive reactance in addition to resistance. In a well matched antenna the capacitive or inductive reactance is balanced out leaving a mostly resistive load. But in a poorly matched system such as short circuit, faulty antenna, non-resonant, or no antenna there will be a lot of capacitive or inductive reactance. This is transformed by the transmission line (feedline cable) and appears to the transmitter as if you have connected an inductor or capacitor plus the resistive component across the output. Note that due to the length of the transmission line a capacitive reactance at the antenna may look inductive at the transmitter and vice versa. The effect of adding capacitance or inductance at the transmit output stage is to de-tune the final. In a tube output stage like a linear amp this can cause the same sort of flash over events as a voltage standing wave peak. In a transistor final it can cause excessive current and burnout the transistors. Less severe detuning will cause mismatch between the transmitter output and the coax feedline, resulting in mismatch loss and reduced output power being delivered to the antenna.

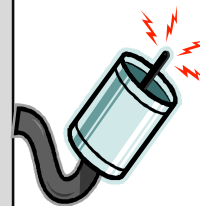
If you are using non resonant antennas or antennas designed to present a higher or lower impedance than 50 Ohms, you should ALWAYS use an Antenna Tuner. Actually an antenna tuner in the shack does not tune the antenna it is really an antenna matching unit. It is not capable of altering the impedance or resonant point of the antenna. To actually 'tune' an antenna you must change its physical or electrical length or other parameters, for example the Steppir antenna controller adjusts the length of the elements and so the Steppir controller could legitimately be called an antenna tuner. The same would apply to a screwdriver antenna controller or the remote tuned capacitor on a magnetic loop.

There is great controversy about whether antenna tuners do actually 'tune' the antenna. Some very experienced PHD qualified experts insist that they do. I think that the issue is whether we are referring to the radiating part of the antenna or the total antenna system including the (hopefully) non-radiating feed line, tuner, and transmitter. I believe that the experts who state that the tuner makes the antenna resonant are assuming the tuner or matching arrangement is at the antenna end of the feedline coax and in that case it is true that the tuner matching capacitor(s) and inductor(s) affect the electrical length of the antenna to bring it to resonance in much the same way as the gamma





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match, loading coil, or other matching hardware on the antenna itself. But that resonant point may not be a 50 Ohm match although the inductive or capacitive reactance will be balanced out at resonance. If the resonant point is not a 50 Ohm match the tuner may tune away from the resonance point slightly to better match the transmitter and feedline to the antenna.

A tuner located at the shack sees a complex impedance that been transformed by the transmission line. This is dependent on the length and impedance of the transmission line and will normally be completely different to the complex impedance at the antenna. The tuner in the shack matches the complex impedance on its input to the transmitter and this does not necessarily bring the antenna to resonance. You can prove this by placing an SWR meter between the tuner and the antenna. When 'tuned' you can have a good match to the transmitter but there may still be higher SWR on the antenna side of the tuner. This would not be the case if the antenna was resonant.

If you can't match an antenna using the tuner in your shack, you can use the transmission line transformation to your advantage. Add a few feet of additional feedline cable and the complex impedance seen at the tuner will be different which may allow you to find a match within the range of your tuner. Sometimes this trick can be used to allow you to use a non-resonant antenna or an antenna cut for a particular band such as 10m, 20m, 40m or 80m on a non-harmonically related band such as 12m, 17m or 30m.

The antenna matching unit in your rig or the shack (usually known as a tuner) uses inductors and capacitors to transform the complex impedance of the feedline and antenna so that the transceiver sees a mostly resistive (not capacitive or inductive) load at around 50 Ohms. The section of feedline coax between the radio and the tuner has no standing wave so there is no risk to your transceiver. The section of coax between the tuner and the antenna may still have a standing wave because the coax feedline is a different impedance to the complex impedance of the antenna load, however high SWR does not necessarily mean a lot less signal is being radiated.

Where the tuner is located is a balance between convenience and performance. If the tuner is placed at the antenna end of the feedline, the whole feed cable is matched so there are no multiple reflections causing increased feed line loss. In other words in a high SWR situation more power will be radiated if the tuner is at the antenna end. But a tuner at the antenna is not very convenient to adjust unless it is a fixed match for a mono-band antenna, a remote tuned matching arrangement, or an auto tuner. A manual or auto tuner at the transceiver end or internal to the transceiver allows you to adjust the SWR match more easily without worrying about remote power feed and control lines, weatherproofing and temperature issues.

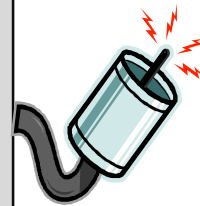
While researching this article I came across a rather funny posting on a web blog which pointed out how misunderstood this subject often is. The ham stated that he had a tuner in the shack with a built in SWR meter followed by another SWR meter and that most often the two meters did not agree. On some occasions the tuner read an SWR of 1:1 and the meter on the coax between the tuner and the antenna read more than 2:1. There were many uninformed and confusing replies to this posting until someone pointed out that this is entirely normal and exactly what you should see. Of course if he had placed the meter on the coax between the rig and the tuner then both meters would agree. It is possible for your SWR meter to be showing a good SWR but for the antenna to perform poorly.

Here are two common complaints.

'I upgraded my feedline to a better type of coax but my SWR got worse, what happened?' and 'I added more radials on my vertical antenna but my SWR got worse, what happened?'



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The answer is either high coax loss or often in the case of short vertical antennas high ground loss. If the coax loss is high the amount of reflected energy arriving back at the tuner or transceiver is low, so the antenna looks like a better match than it really is.

Changing to a low loss coax exposes the poor antenna. For a 3dB feedline loss in a system with a real SWR of 5:1 the indicated SWR at the tuner in the shack is 1.97:1. In a system with a real SWR of 100:1 (a really bad termination like an open or shorted feedline) the indicated SWR of 2.93:1 at the tuner in the shack still does not look too bad. The cable loss is effectively hiding the problem.

Another classic example is the 1/4 wave vertical antenna with insufficient radials which may present a good SWR. Adding more radials will dramatically improve the antenna performance but the reduced impedance at the antenna feed point due to the improved earth plane will cause the SWR to increase. A basic 1/4 wave antenna with a good earth plane should be around 36 Ohms. I have seen commercial antennas advertised that require 'a minimum of 40 feet of coax feed'. The manufacturer is using coax loss to hide poor antenna design and matching. In the case of the 1/4 wave vertical it hides the mismatch caused by having either a good earth system or a poor earth system.

The final outline is;

1. High SWR at the transmitter can damage your rig because the final amplifier will be de-tuned possibly causing a high voltage or current situation in the final stage of the transmitter.  
Using an antenna tuner will protect the rig by transforming the antenna and feedline complex impedance back to where it should be.
2. High SWR will not significantly reduce your power, provided you are using an antenna tuner to protect your transceiver, and your coax loss is low.
3. High loss coax can really reduce your output power. Even in a well matched antenna system a coax with a 3 dB loss will waste half of your transmitter power as heat, allowing the antenna to radiate the other half.
4. High feedline loss and high SWR multiplies the coax loss, causing very little power to be radiated.  
For example, if you have a low loss feedline of 0.2dB, the radiated power from a 100W transmitter reduces from 95.5W at an SWR of 1.01:1 to 88.8W at an SWR of 5:1. That is only an additional 0.3dB loss due to the poor SWR. Compare that to a feedline loss of 3dB.  
You have already lost half your power in feedline loss and the poor SWR costs you an additional 2dB leaving you with a measly 31.3W being radiated from the antenna.